

14 GEORGE V

SESSIONAL PAPER No. 15

A. 1924

REPORT
OF THE
DEPARTMENT OF MINES
FOR THE
FISCAL YEAR ENDING MARCH 31, 1923

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OTTAWA
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1923

No. 2005

*To General His Excellency the Right Honourable Lord Byng, of Vimy, G.C.B.,
G.C.M.G., M.V.O., Governor General and Commander-in-Chief of the
Dominion of Canada.*

MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII, chapter 29, section 18, the report of the work of the Department of Mines, for the fiscal year ending March 31, 1923.

CHARLES STEWART,
Minister of Mines.

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REPORT
OF THE
DEPARTMENT OF MINES

FOR THE FISCAL YEAR ENDING MARCH 31, 1923

To the Honourable CHARLES STEWART,
Minister of Mines,
Ottawa.

SIR,—I have the honour to transmit the annual report of the Department of Mines for the year ending March 31, 1923.

Included in this report are the statements of the heads of the various branches of the Department containing details of the operations of these branches. It is gratifying to report that in the conduct of these branches very satisfactory service has been given by the heads, who have endeavoured to direct the operations of their branches with economy and a due regard to the expenditure of public money. Owing to the interlocking functions of the Mines Branch and the Geological Survey and the close relationship of the work of these two branches there is occasional danger of overlapping, but this is overcome by more frequent consultation between the heads and a desire on both sides for closer co-operation, which has resulted in increased efficiency without increased expenditure.

With regard to this question of co-operation in investigations and research, successful efforts have been made by this Department for co-operation with other departments of the Dominion government, with provincial organizations, and organizations outside of Canada, especially with the Bureau of Mines and Geological Survey of the United States.

Proposals of co-operation have met with a hearty response in Washington and every suggestion has been received sympathetically and been given generous consideration. I wish especially to record the appreciation of the Department of Mines for the co-operation of Dr. H. Foster Bain, Director of the United States Bureau of Mines, and his technical officers, in the investigation being carried out in connexion with the carbonizing and briquetting of the lignites of southern Saskatchewan. True, the problem is one common to both countries, but it affords an illustration of the feeling that exists between the two countries in matters affecting technical investigation as well as in other lines of activity.

The Department has also continued and extended the practice of consultation with the provincial departments having to do with the administration or investigation of mineral and other natural resources, with the result that the efforts of the Federal organization are co-ordinated with those of the provincial bodies and public funds are expended to the best advantage.

The same general policy of co-operation is being followed with respect to other departments of the Federal service and assistance has been given to and received from the Departments of Interior, Public Works, Justice, Trade and Commerce, National Defence, and others. In accordance with this policy an arrangement has been made with the Departments of Interior and National Defence, both of which are engaged in topographic surveying, whereby a Board of Topographic Surveys and Maps has been created to co-ordinate the mapping activities of the three departments.

During the month of August, 1922, there was held in Brussels at the invitation of the Belgian government the Thirteenth International Geological Congress and the Deputy Minister was designated as the official delegate to represent Canada at this Congress. The Congress was opened by the King of the Belgians in the Palais des Académies on August 10 and sat for 10 days. It was preceded, as well as followed, by a series of excursions, lasting some three weeks, to points of geological interest throughout Belgium. About three hundred and fifty geologists representing forty countries were in attendance and the papers presented dealt with every phase of geology both pure and applied. Every courtesy was shown to the Canadians attending the Congress and although there were no delegates present from the late enemy countries other countries were well represented, and the meeting was a distinct success. An invitation was accepted from the Government of Spain to meet in that country for the Fourteenth Congress in 1925.

Although the Department is concerned mainly with technical investigations into the development and utilization of our mineral resources, we cannot overlook the effect of foreign trade conditions on this development.

Canada's foreign trade in mineral products has been somewhat adversely affected by the application of the Fordney-McComber tariff law in the United States in September, 1922, and during his visit to Europe some effort was made by the Deputy Minister, with co-operation of the Department of Trade and Commerce and the Imperial Mineral Resources Bureau in London, to inquire into an outlet, particularly in Great Britain, for products that were affected by that tariff. Owing to the condition of exchange and the unsettled state of affairs in Europe the results were not very satisfactory, though the information gathered will no doubt be useful as soon as these affairs reach a more settled condition. Lists, however, were obtained of the more important dealers in mineral products in Great Britain and Belgium and it is the intention to supplement these by similar lists from other European countries, so that the information may be supplied to those producers in Canada seeking foreign markets. The situation as it was found to exist in Great Britain with respect to non-metallics has been set forth in a paper prepared by H. S. Spence, of the Mines Branch, and distributed by that branch.

Advantage was also taken by the Deputy Minister of the visit to Great Britain to attend meetings of the Board of Governors of the Imperial Mineral Resources Bureau in London and there has resulted as a consequence a closer co-operation of the Department with the Bureau, which should work to the mutual advantage of both organizations and a better understanding in London of the conditions and opportunities of the mining industry of Canada.

The mineral resources of Canada are among its greatest natural assets, and, owing to our natural climatic conditions and the relatively limited area of the country capable of agricultural development, the mining industry must necessarily occupy a relatively larger place in our economic development than in those countries of the world more fortunately endowed with respect to climate. Mining is not affected by climate and can be carried on irrespective of it. The importance of this industry is indicated by the growing increase in the annual production of minerals per capita, which has risen during thirty-five years from \$2.23 to \$26.40 a head of population. This curve of production is increasing from year to year until it should ultimately exceed that of any country in the world. The two essentials to increased mineral production are markets and capital. Under present conditions the former is the more important and is necessary to encourage the latter. Owing, however, to the conditions mentioned above, namely adverse tariffs or the conditions of exchange, foreign markets are today difficult for us to enter. It is urgently necessary, therefore, that we should develop home markets by the establishment of industries complementary to the mining industry, so that the products of our mines may be

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utilized for manufacture into finished articles. A study of our mineral trade balance will show several instances where the raw material for a manufactured article is produced in this country, but is shipped outside for manufacture and is then sold back to us at many times the value of the material in it. The securing of capital for the development of these complementary industries appears to be more in the general interests of the country than capital for the production of raw material, and until those complementary industries are established in our own country the production from the mine will not increase to a stage bearing a proper relation to what we believe to be our potential resources.

The capital invested in the Canadian mining industry is at present derived from three main sources in about the following proportion, namely: Canada, 54 per cent; United States, 31 per cent; Great Britain, 13 per cent. Only about 2 per cent is provided by other countries than those three.

The large proportion of United States capital in this country is only what might be expected because of the proximity of that country to us, but it would be to our advantage and would result in greater cohesion in the British Empire if a larger proportion of British capital could be persuaded to invest here. To accomplish this it will be necessary to secure the confidence of the British public in mining investments in Canada and to give a greater measure of protection than it has enjoyed in the past.

The recurrence during past years of coal shortages in eastern Canada was responsible for a decision on the part of the Government to set up an organization to study the causes of these shortages, to keep constantly in touch with the fuel situation, and to work out a policy for the permanent solution or reduction of fuel troubles. The Dominion Fuel Board was organized in November for this purpose under the chairmanship of the Deputy Minister of Mines, assisted by certain technical officers from both this Department and the Department of Interior, whose duties touched upon the coal problem. Sittings of the Board were held semi-weekly or weekly and all its members gave generously of their time to the work of the Board. The first duty of the Board was to obtain a clear idea of the various phases of the fuel situation in Canada and having obtained this a programme of investigation was outlined which will be carried out during 1923. The acute fuel area covers the province of Ontario and the western part of Quebec. Owing to the distance from our own coal fields in the west and the apparent inability in the past of the Maritime Province coal fields to produce a sufficient quantity to meet its needs, this area has been dependent almost entirely on the United States coal fields for a fuel supply. Through the efforts of the Board, British coal producers were induced to inquire into the Canadian market, particularly on the St. Lawrence, and it is expected that a considerable quantity of British coal will be shipped to Montreal and other points during the season of 1923. The entry of British coal into the Canadian market will overcome to some extent the unsatisfactory situation in which our acute fuel area found itself of being dependent entirely on one source of fuel supply. In addition, the Board co-operated with the government of Alberta, and coal producers of that province, in endeavouring to introduce Alberta coal into the Ontario markets.

The Joint Peat Committee, organized in 1918, of representatives of the Federal and Ontario governments, concluded its work at the close of the fiscal year and was then disbanded. The object of the Committee was not to manufacture peat fuel for the market, but to develop a process and evolve machinery for the manufacture of peat fuel. The results of this work have been entirely satisfactory; the Committee has shown that a satisfactory fuel can be manufactured on a commercial basis, and that there is a large demand for this fuel. It is, however, not the policy of the Government to go into the manufacture of peat fuel on a commercial basis, but with the results obtained by the Peat Committee private capital should have no hesitation in going into this business.

As shown by the production returns of 1922 the mining industry is recovering from the depression which existed in it during the previous year and a half. The recovery, however, is not uniform, for certain mineral products react more quickly than others to changes in business conditions. The most notable recovery is that of gold, and the gold mines of northern Ontario and the adjacent fields of Quebec have been attracting more attention from the investor as well as the prospector than any other part of Canada.

Some interest has been created by the reported discovery of placer gold at Stag bay in Labrador and although the Department has no first hand knowledge of these reported occurrences of gold it has made public in the form of a brief paper what information it possesses regarding the geological features that have a bearing on the probable existence of placers in that region. This paper is included as an appendix to this report.

An organization chart of the whole Department is included with this report, which shows at a glance the units into which it is divided and gives an idea of the activities with which it is engaged. Not only has the Department taken on more duties, especially in connexion with the fuel problems of the country, but the demands made upon the services of the technical staff by the public are growing from year to year, so that it is becoming increasingly difficult for the administrative officers to co-ordinate this increased demand with the urgent necessity for economy in government expenditures. Requests for reports and investigations made from all parts of the country cannot all be fully met, nor is it possible to take up all the problems in technological research that confront the mining industry of this country. Selections consequently have to be made of those fields of investigation and research that are most urgent or give promise of the greatest return for the amount of money and effort to be expended. Problems present themselves in the field of fuels, of ore dressing, and metallurgy, which neither our equipment nor our limited staff will allow us to cover, and the annual programme of work in these fields is always greater than can be carried out. If these fields are to be satisfactorily covered it will be necessary to consider plans for the future of the Fuel Testing and Ore Dressing station in Ottawa which in its present condition is an outgrowth of the requirements of the moment and has been added to and extended as the need for a particular investigation arose.

Your obedient servant,

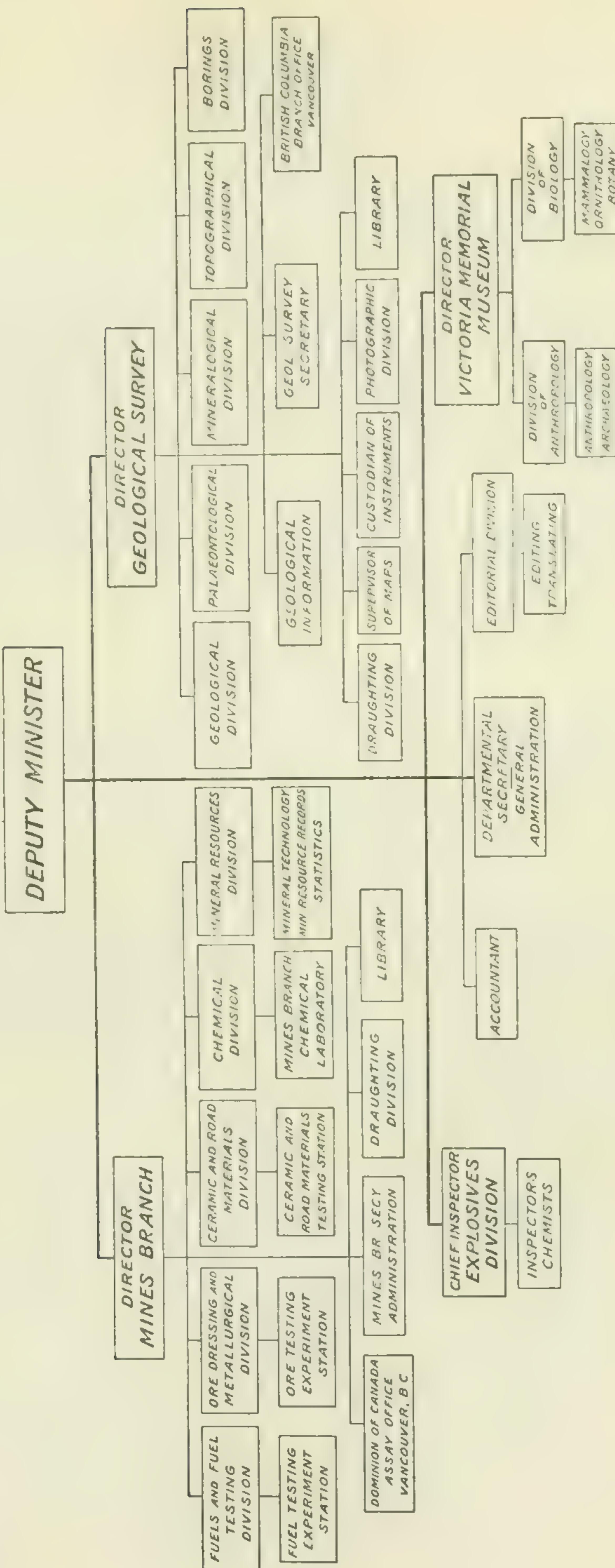
CHARLES CAMSELL,
Deputy Minister.

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ORGANIZATION CHART
DEPARTMENT OF MINES



GEOLOGICAL SURVEY

W. H. Collins, Director

ORGANIZATION AND CHANGES IN STAFF

No change in organization was made during the fiscal year 1922-23. A statement of the organization can be obtained from the Annual Report for the year ending March 31, 1921.

C. E. Cairnes and J. F. Wright were appointed as assistant geologists, J. A. Macdonald as junior topographical engineer, A. T. Hinge as map draughtsman, and Miss E. A. James as assistant photographer, during the year.

The Geological Survey sustained a severe loss through the death of J. D. MacKenzie, geologist, on December 16, who succumbed to an operation upon a wound received in 1918 while serving with the Canadian expeditionary forces in France. The scientific strength of the Survey was also much impaired by the resignation of R. A. A. Johnston, Chief of the Division of Mineralogy, owing to ill health. Resignations were also received during the year from W. S. McCann, associate geologist, and Alexander Braidwood, senior map draughtsman.

OFFICE WORK

A principal difficulty that has to be contended with in the work of the Geological Survey is the lack of accurate large scale geographical and topographical maps, which are a pre-requisite to geological work. This difficulty is now being reduced in a manner that gives promise of its elimination within a reasonably short time if a moderate amount of assistance is accorded. The Topographical Division, which is charged with the survey and compilation of base maps needed, and is, therefore, of fundamental importance in the organization of the Geological Survey, has now nearly regained its pre-war effective strength, and there has been a corresponding recovery in output of work. This work is restricted to areas which are mineralized or are otherwise of geological concern, and is thus wholly directed towards satisfying the needs of the Geological Survey, although it is carried out in units and according to standards that render the maps suitable for other engineering, industrial, and scientific purposes and contributory to the systematic primary mapping of Canada. Although the volume of maps produced is not yet great enough to meet the Survey's need, it is hoped that this will be overcome gradually by an increase in the staff of topographers.

The maps compiled by the Geological and Topographical Divisions are either engraved on copper by the Engraving Division or drawn for photolithography, by the Draughting Division, depending upon the nature of the results required. During the year both divisions have accomplished all that was required from them, the volume of work turned out by the Engraving Division being particularly satisfactory. Much credit for the large amount of work accomplished is also attributable to the ability and exceptional industry of Mr. Alexander Dickison, Supervisor of Map Preparation and Reproduction, and his staff, in preparing manuscripts for engraving or draughting and supervising various stages of their reproduction. Since reclassification by the Civil Service Commission the Draughting Division has been reduced by resignations to an extent that renders it difficult to prepare our maps for publication. An improvement in the rating of some of the positions is required to bring the division to its normal strength.

FIELD OPERATIONS

Thirty-nine parties carried on field work in various parts of Canada during the summer of 1922. In large part this work is intended to assist prospectors and explorers in the discovery and development of the mineral resources of the country by mapping the rock formations and investigating and describing the mineral-bearing possibilities of each formation. Increasing attention also is being devoted to investigating and compiling inventories of Canada's resources of coal, iron ore, petroleum, and other minerals. The topographical parties, while engaged in preparing base maps for geological use, mainly in areas containing mineral deposits, are preparing these maps on scales and according to standards which make them contributory to the systematic primary mapping of the country.

Concurrently with these operations that have an immediate economic purpose in sight, an opportunity is afforded to most parties to carry on more purely scientific studies, the results of which each year help to transform the exploration of our mineral resources from a haphazard search to one guided by increasingly well understood principles. It has become recognized, for example, that the great series of granitic intrusions, known as the Coast batholith, that extends the length of British Columbia, was the source of a large share of the metalliferous deposits in the province and that this relationship should be a governing consideration in directing prospecting operations. Opportunities are also afforded to prosecute studies in mineralogy, palaeontology, and the other related sciences, and to collect mineral specimens, fossil remains, and other materials for the Victoria Memorial Museum.

GEOLOGICAL FIELD WORK

A brief statement of the work of each party follows.

British Columbia and Yukon

W. E. Cockfield commenced the geographical and geological mapping, for publication, on a scale of 1 inch to 4 miles, of an area of 800 square miles around Whitehorse. The area is part of the eastern margin of the Coast batholith and includes the copper ore deposits at Whitehorse, the gold-silver deposits of Wheaton district, and various other evidences of mineralization. Two seasons of field work will be required to complete the area.

George Hanson continued the geographical and geological exploration of the eastern margin of the Coast batholith between Portland Canal district and the Canadian National railway. He also investigated the petroleum-bearing possibilities of Kitsumgallum and Kispiox valleys. A full report upon this work is given in the Summary Report of the Geological Survey for 1922, Part A.

Victor Dolmage completed a geological reconnaissance of the Pacific coast northward to Prince Rupert. A full account of this work is given in the Summary Report, Part A.

J. D. MacKenzie completed detailed mapping and study of the underground structure of the northern part of the Nanaimo coal basin, on the east side of Vancouver island. An estimate of the coal reserves in this field was also made.

W. A. Johnston and W. L. Uglow were engaged in detailed geological mapping of the placer and drift deposits and of the underlying bedrock formations in Barkerville map-area, Cariboo district. Interest in the Cariboo placers has been quickened by a new discovery of gold placers at Cedar creek. The placers are chiefly of Tertiary age and have been obscured by glacial action and the covering of boulder clay left by the ice-sheet, a condition which renders

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prospecting unusually difficult and calls for a careful geological consideration of the preglacial drainage. The bedrock formations are being studied by Dr. Uglow with a view to throwing further light upon the source of the gold in the placers. Preliminary reports upon the work accomplished are given in Part A of the Summary Report.

C. E. Cairnes, who had spent the two preceding seasons in mapping and studying the ore deposits of Coquihalla map-area, near Hope, extended his investigations southward towards the International Boundary into an area that is comparatively little known, but in which a variety of minerals are reported to occur. A full report of this work is published in Part A of the Summary Report.

M. F. Bancroft concluded geological mapping of the Lardeau area, southeast from Revelstoke. The area contains occurrences of silver-lead-zinc minerals, talc, Iceland spar, and other minerals, and also links up the geology of southern British Columbia with that along the main line of the Canadian Pacific railway.

G. A. Young, in co-operation with the British Columbia Department of Mines, commenced a detailed investigation of the iron ore resources of the province. The purpose of the investigation, which will extend over several years, is to ascertain whether there are in the province enough iron ores suitably located and of satisfactory qualities to supply a future iron and steel industry on the Pacific coast, if the other essential requirements for such an industry are available. The question of establishing a Coast iron and steel industry has been under consideration at various times in recent years, and there is need for exact information regarding the basic requirements. During 1922 examination was made of the following deposits:

Kitchener, in Nelson Mining Division.

Sand creek and Bull river, in Fort Steele Mining Division.

Texada island, Redonda island, Seymour inlet, and

Phillips arm, in Nanaimo Mining Division.

F. H. McLearn mapped and investigated in detail the geological succession of Triassic and Cretaceous formations that constitute the foothills of the Rocky mountains on Peace river above Hudson Hope. He also examined in detail the deposits of high-grade coal which occur in the canyon on Peace river just above Hudson Hope. A full account of these coal deposits is given in Part B of the Summary Report for 1922.

Northwest Territories

In 1921 the Geological Survey commenced a systematic mapping and investigation of the petroleum and other mineral-bearing possibilities of the country accessible from Mackenzie river. This work was continued in 1922 by three parties, all of which were engaged in surveying canoe routes and determining the geological succession and structure of the region.

G. S. Hume investigated the country between Norman and the mouth of Carcajou river.

M. Y. Williams worked between Wrigley and the mouth of Great Bear river.

E. J. Whittaker worked between Providence and Simpson. Reports upon this work are published in Part B of the Summary Report for 1922.

Alberta

D. B. Dowling made further study of the geological structure and the potential supplies of water and gas in the "artesian" area southeast from Medicine Hat. He also investigated alleged discoveries of placer gold and

platinum in Smoky and Red Deer rivers, and the underground water resources of a dry area near Peace river. The results of these investigations are given in Part B of the Summary Report.

J. R. Marshall continued systematic geological mapping and investigation of the coal resources of the Kananaskis map-area.

Saskatchewan and Manitoba

F. J. Alcock, assisted by Paul Armstrong, mapped in detail an area of about 50 square miles surrounding and including the Mandy copper ore deposit and the Flinflon gold ore deposit. The occurrences of gold at Elbow lake were also examined. Reports on both areas are published in Part C of the Summary Report for 1922.

J. F. Wright commenced the detailed geological mapping on a scale of 1 inch to 1 mile of the Rice Lake mineral area east of lake Winnipeg. A full report and map appear in Part C of the Summary Report.

Ontario

T. L. Tanton continued geological mapping and investigation of the silver, zinc, iron, and other mineral deposits lying northwest of lake Superior between Port Arthur and Nipigon.

Ellis Thomson completed geological mapping, on a scale of 1 inch to 1 mile, of an area of 400 square miles near Missinaibi, in Michipicoten district. The area contains deposits of pyrite and gold.

Pentti Eskola completed geological mapping of an area of Huronian formations near lake Panache, southwest of Sudbury, and also part of another area of the same formation, north of Blind River. Dr. Eskola is a member of the Geological Survey of Finland, temporarily carrying on research work at the Geophysical Laboratory of the Carnegie Institution, Washington, and advantage of his presence in America has been taken to have him associated during the summer with the Geological Survey, Canada. The geological problems of Finland are very similar to those encountered by Canadian geologists who work in the Precambrian shield, and a practical exchange of ideas between Dr. Eskola and officers of the Geological Survey has been mutually profitable.

H. V. Ellsworth continued a systematic study of the radioactive and rare-element minerals of Canada, which was begun in 1921. These materials, for which new industrial uses are being found, and which are the subject of much present investigation, have been found in Canada chiefly in the crystalline rock formations of eastern Canada. Mr. Ellsworth's work during 1922 was confined to the territory between Parry Sound and Ottawa.

M. E. Wilson continued detailed geological mapping, on a scale of 1 inch to 1 mile, of an area around Madoc, in which fluorspar, talc, gold, pyrite, and other minerals occur. He also investigated talc deposits in southern Quebec in connexion with a systematic study of the talc resources of Canada.

Joseph Keele completed an investigation of the clays and shales of Ontario. A full report upon the clay and shale resources of Ontario, similar to reports already issued for the other provinces of Canada, will shortly be published.

Quebec

Since the discovery of the Dome ore deposit at Porcupine in 1909 the gold mining industry in northeastern Ontario has increased until the production for 1921 was about \$18,000,000. Geological investigation has shown fairly conclusively that the gold ore deposits are connected in origin with small intrusions of granitic rocks and are chiefly localized in the vicinity of these intrusives.

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Up to 1922 nearly all the important discoveries had been made in Ontario, although apparently the same geological conditions continue eastward into Quebec. In 1922 H. C. Cooke and W. F. James commenced the detailed geological mapping of an area of about 800 square miles in Quebec, south of lake Abitibi and adjacent to the Ontario boundary, with the object of encouraging prospecting for gold, and of providing prospectors with serviceable maps. Active prospecting commenced almost simultaneously, a number of discoveries of gold-bearing veins were made during that summer, and it is expected that the activity will increase in 1923. Reports and maps of the work done by Mr. Cooke and Mr. James are published in Part D of the Summary Report for 1922.

Aleph Anrep surveyed and measured the contents of four peat bogs in the vicinity of Quebec city. This work is in continuation of a systematic survey of the peat resources of Canada. A full report, illustrated with plans of the peat bogs, appears in Part D of the Summary Report.

A. T. McKinnon collected in Ontario, Quebec, and the Maritime Provinces minerals for exhibition in the Victoria Memorial Museum and for use in the preparation of educational collections.

Nova Scotia

E. R. Faribault continued, near Middleton, the systematic geological and geographical survey, on a scale of 1 inch to 1 mile, of Nova Scotia. A detailed investigation and survey was also made of the Nietaux-Torbrook iron range.

W. A. Bell commenced a detailed investigation and mapping of the geological succession and structure of the Pictou coal area, near New Glasgow. He also continued similar work in the Sydney coal area.

C. M. Sternberg collected fossil remains from the Coal Measures at Joggins, for preparation of an exhibit in the Victoria Memorial Museum at Ottawa illustrative of conditions during the Carboniferous period.

TOPOGRAPHICAL DIVISION

W. H. Boyd, Chief Topographical Engineer, reports as follows:

Topographical mapping was carried on by the division during the field season in British Columbia, Alberta, Manitoba, Ontario, Quebec, and New Brunswick. The purpose of this work is to provide accurate and reliable base maps for the various requirements of the Geological Survey. The Survey's activities range from explorations covering wide areas to detailed investigations over very limited areas, and necessitate base maps on scales from 1 inch to 8 miles, to 1 inch to 400 feet. The greater part of the work, however, requires, as a rule, a scale of 1 inch to 1 mile. This scale is considered to be the standard scale. The size of sheet adopted is 15 minutes of latitude and longitude. The field and office work, consequently, has been standardized throughout and results of a high quality are maintained. The contour interval used is 25, 50, or 100 feet, according to the nature of the country.

The mapping requirements of the Geological Survey carry the topographical engineer into all parts of Canada, with its widely varying types of country and its consequent diversities in transportation methods. The scale of the map may be any within the range mentioned above. To meet successfully these varying conditions, the topographical engineer must have a wide experience in topographical work in all types of country, and in working on different map scales. The engineers of this division have been carrying on this specialized map work for many years, and are well qualified to meet any demands that may be made upon them.

It is the aim of the division to maintain a standard of work such that the resulting maps will not only fill the needs of the Geological Survey, but will satisfy the demands of all those who require accurate topographical maps for

their use in mining development, highway construction, and other industrial and engineering operations. The communications received from these various sources indicate that the maps produced by the division have fulfilled these outside requirements.

During the field season of 1922, two parties performed main control for mapping purposes, and seven parties carried on topographical mapping.

MAIN CONTROL FOR TOPOGRAPHICAL MAPPING

S. C. McLean continued the triangulation control in New Brunswick which was commenced last year. This control is based on the primary triangulation of the Geodetic Survey of Canada in that district. It will form a secondary system to that of the Geodetic Survey and is for the direct purpose of controlling the topographic map work in the region between Grand Lake and Moncton. This control established the geographical position of the Minto standard 1-mile sheet, to which later reference is made.

The progress of the work was greatly hampered by conditions of visibility during the day. With the use of suitable station lamps and night observation, this difficulty will be overcome in future and more rapid progress made in the work.

R. C. McDonald carried out the control surveys for geographical map sheets in northern Manitoba. The Air Board had generously agreed to co-operate in this work by providing observation flights and transportation of supplies during the season. At the beginning of the work Mr. McDonald's party and supplies were transported by aeroplane from Wintering lake to Wuskwatim lake. Unfortunately this was the only flying operation that could be carried out, on account of trouble with the machines later on in the season.

The route surveyed was from station 205C on Burntwood river, a little above Wuskwatim lake, established by the Department of the Interior survey in 1920. From this station Burntwood river was followed up to Burntwood lake, thence over the height of land to Shaving point on Churchill river, and up the Churchill to Sisipuk lake where a connexion was made to the second meridian. Returning to Shaving point, the survey was carried down Churchill river to Southern Indian lake. On this stretch of the river, Granville lake was included in the survey.

The work was successfully completed. About 740 miles of subtense traverse was run, using transit and filar micrometer eye-piece. Both banks of the rivers were mapped. In all about 1,500 miles of shoreline was mapped. Wooden posts were left at all points where side routes might possibly be followed at some future date. A control survey for future as well as present mapping requirements has thus been provided for geological and other needs.

TOPOGRAPHICAL MAPPING

A. C. T. Sheppard completed the mapping on Vancouver island, B.C., which was commenced last year. This work, which comprises a total land area of about 330 square miles, extends from the town of Headquarters on the north, to Bowser station on the Esquimalt and Nanaimo railway on the south and includes all the northern part of Nanaimo coal basin. The mapping is standard 1-mile work with a contour interval of 50 feet. This work was rendered difficult in parts owing to the dense timber and undergrowth, and the lack of trails inland, but was successfully completed, and the resulting map will meet the requirements.

J. A. Macdonald, junior topographical engineer, who was appointed to the staff early in the year, was attached to this party and rendered efficient service throughout. Thanks are due to the Geodetic Survey of Canada, whose co-

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operation, by executing the main triangulation control for this season's mapping, materially assisted in the progress of the work.

Acknowledgment is also made of the valuable assistance rendered by the Canadian Collieries (Dunsmuir) Ltd., who generously provided Mr. Sheppard information and working plans of their properties for use in the work.

R. Bartlett continued the mapping of the standard 1-mile sheets along Kootenay valley, B.C. This work, which was commenced last season, has been greatly hindered by smoke from forest fires. Sufficient field work, however, has been accomplished for the publication of the two sheets bounded by latitudes $49^{\circ} 00'$ and $49^{\circ} 15'$ and longitude $116^{\circ} 30'$ and $117^{\circ} 00'$.

D. A. Nichols completed the detail mapping, on the scale of 1,000 feet to 1 inch with contour interval of 50 feet, of an area of 25 square miles in the vicinity of Allenby (Copper) mountain, south of Princeton, B.C. This map was made for a detailed geological investigation of the copper ore deposits and should also be of service in mining operations.

W. H. Miller completed the Cadomin standard 1-mile sheet, in Alberta. The boundaries of this sheet are latitudes $53^{\circ} 00'$ and $53^{\circ} 15'$ and longitudes $117^{\circ} 15'$ and $117^{\circ} 30'$. The contour interval used is 100 feet. This sheet includes the Cadomin and Luscar collieries.

E. E. Freeland was engaged in mapping the three standard 1-mile sheets included between latitudes $48^{\circ} 15'$ and $48^{\circ} 30'$ and longitudes $88^{\circ} 45'$ and $89^{\circ} 30'$. These sheets are in Ontario, and include the cities of Fort William and Port Arthur, also Thunder cape and Silver islet. The contour interval used was 50 feet. About 210 square miles, land area, was completed. About 40 square miles remain to be done. The area presents many difficulties that require special study in order that suitable methods may be evolved, which will enable the work to be carried out in the most economical manner.

Mr. Freeland acknowledges the generous co-operation from Mr. F. Harcourt, resident engineer of the Department of Public Works at Port Arthur, who provided copies of their detail plans of the harbours of Port Arthur and Fort William for use in the work, and who also rendered valuable assistance in many other ways.

K. G. Chipman commenced the mapping of the standard 1-mile sheet included between latitudes $48^{\circ} 45'$ and $49^{\circ} 00'$, longitudes $66^{\circ} 00'$ and $66^{\circ} 15'$. This area lies in Gaspe district, Quebec, and includes the Federal Lead and Zinc mine to the south of mount Albert to the north. The contour interval used is 100 feet.

This region presents many difficulties with respect to weather conditions and transportation. Heavy fogs and rain are prevalent. Transportation is wholly by back-packing. In view of these conditions and the inaccessibility of the area, it was considered inadvisable to attempt to maintain the usual high standards in the actual map work. The expense would not have been justified. However, the main control was carried out over the whole area with the usual accuracy, and the surveys that were run were also of the customary grade. It was in the manner of using the plane-table intersection method, for filling in topographical detail, that a certain latitude was allowed. The resulting map will be a very useful type and will fulfil the requirements for a long time to come. Considering the many difficulties met with excellent progress was made. The main control triangulation for the whole sheet was accomplished. This is based on the two stations established by the Geodetic Survey of Canada on mount Albert. Seventy square miles of mapping was completed. Of the whole time spent in the area, one-half was taken up on the main control work; of the remaining half, 60 per cent was lost on account of fogs and rain.

A. G. Haultain completed the standard 1-mile sheet which includes the Minto coal area in New Brunswick. This sheet is included between latitudes

46° 00' and 46° 15' and longitudes 66° 00' and 66° 15'. The contour interval used was 50 feet. As a considerable part of this area has very little relief, is difficult of access, and is covered with thick brush with open patches of heath and marsh, it was found difficult in places to satisfy the standard requirements, especially as regards control. This difficulty was met as satisfactorily as was possible and the resulting map is a good specimen of what can be accomplished in that particular type of country.

Mr. Boyd spent three weeks in August at Matane, Quebec, making a 400-foot detail topographical plan of the harbour and adjacent country. A contour interval of 10 feet was used. S. G. Alexander accompanied the writer and rendered material assistance in the work. This map was made for the Department of Public Works in connexion with their harbour improvement investigation in the locality. Photo copies of the map were sent to the Department of Public Works early in October.

OFFICE WORK

The office work of the division consists in the compilation, assembling, drawing up, and inking-in of the various map sheets. This involves the computation of data of various sorts obtained in the course of field work. Some maps are the result of photographic surveys, others of plane-table methods of survey, and others, combinations of both.

The standard map sheets are compiled on the scale of 3,000 feet to 1 inch. These are drawn up in pencil and inked in by the topographical engineers. The completed manuscript map, when finished, i.e., all inked in, is accompanied by a name sheet, and other miscellaneous data. These are submitted to the Supervisor of Map Preparation and Reproduction, who is responsible for the reproduction of the map.

Besides the standard topographical map work, the division undertakes the compilation of geographical base maps for geological requirements. These may be on the scales of 1 inch or 4 inches to the mile. The necessary control work for these maps is obtained in the field by the division.

J. W. Spence, who was appointed early in the year as a junior topographical engineer, has very materially assisted the office work of the division and has rendered efficient services throughout.

By the efforts of individual members of the division, nearly all the back work has been brought up to date. The accumulation of back work was due to the fact that a large proportion of the staff had been serving with the Canadian Expeditionary Force. The division during their absence was unable to complete the work left unfinished and undertake the new work required from year to year.

It is encouraging to the division to note that by an Order in Council, dated March 17, two new positions of junior topographical engineers have been added to the establishment of the Geological Survey. These positions are necessary for the division to undertake successfully the increasing demands of the Geological Survey for base maps. It is to be hoped that still more assistance will be given to the division in this way, for the staff is still too small to undertake all the work required of it.

MINERALOGICAL DIVISION

Eugene Poitevin, Acting Chief of the Division, reports as follows:

R. A. A. Johnston, who had been absent on sick leave since November, 1921, was superannuated on July 1, after thirty-four years of conscientious and efficient service, first as chemist, later on as mineralogist, and chief of this

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division. Since November 1, 1921, Eugene Poitevin, has acted as chief of the division.

FIELD WORK

H. V. Ellsworth spent about four months of the summer in Ontario investigating occurrences of rare minerals. The rare minerals contain radium, uranium, thorium, beryllium, tantalum, columbium, lithium, rubidium, caesium, zirconium, cerium, and other elements of present or potential value. More extended reference is made below to this work.

A. T. McKinnon, mineral collector, visited between July 4 and September 6, a number of localities in Ontario, Quebec, New Brunswick, and Nova Scotia and collected a large quantity of mineral specimens required for the preparation of Educational Collections.

LABORATORY AND OFFICE WORK

During the year just ended the staff of the division had to answer over 600 personal inquiries on the part of visitors seeking mineral determinations or information on matters related to the mining industry. This year the mineral specimens sent to the Geological Survey that could be reported upon without an elaborate chemical or optical examination did not reach this division, being investigated by members of the Geological Division. Even with this helpful arrangement some seven hundred specimens were determined and described as to their economic possibilities in four hundred and fifty-three memoranda which were sent as follows:

Ontario.....	100	Quebec.....	142
British Columbia.....	63	Nova Scotia.....	33
New Brunswick.....	40	Manitoba.....	32
Alberta.....	30	Saskatchewan.....	6
Yukon.....	1	Prince Edward Island.....	1
Foreign.....	5		

The above mineralogical investigations were carried on by Eugene Poitevin, who in addition to carrying the administrative work of the division also completed a report entitled "Comparative Study of Some Platiniferous Rocks from Tulameen, B.C., and the Ural Mountains."

H. V. Ellsworth has been engaged in laboratory investigations of the rare element minerals obtained in the course of field work. Considerable time has also been spent on research looking toward improvements in the methods of analysis for these minerals. The age of the Precambrian granites and pegmatites as indicated by the uranium-thorium-lead ratio in radioactive minerals has been accurately determined for several districts in Ontario. This phase of the work is already yielding results of considerable prospective importance in geological correlational work.

M. F. Connor, rock analyst, completed the following analyses:

ROCK	LOCALITY
Typical serpentine from serpentine belt	Fifteenmile creek, 1 mile above Kettle Valley railway
Greenstone	Cleve's trail, $\frac{1}{2}$ mile from the mouth of Dewdney creek
Average specimen of Coast Range granite	Portia siding on Kettle Valley railway
Slate	Across slate belt along Kettle Valley railway
Composite sample limestone	One and three-quarters miles above Nictaux falls, 1,800 feet east of Nictaux river
Two samples of feldspars	N. $\frac{1}{2}$ of lot 4, con. vi, McKellar township, Parry Sound, and N. $\frac{1}{2}$ lot 7, con. X, Parry Sound
Zinc blende	Renfrew county, Ontario
Series of four eruptive rocks from Mount Royal	Island of Montreal
Diabase, graphitic granophyre, and altered grey-wacke	Port Arthur, Ont.

In addition to the above Mr. Connor has also carried on subsidiary work and necessary investigations in connexion with the above results.

MUSEUM OF ECONOMIC MINERALOGY

When the House of Commons was forced to occupy the Victoria Memorial Museum in 1916 the mineral collection of the Geological Survey had to be packed and removed to 227 Sparks street, its present quarters. At that time many minerals were wanted for war purposes and with the generous help of the Exhibition Branch of the Immigration Department, who also supplied specimens and cases, an economic mineral display was prepared in haste. This year all specimens and cases not belonging to the division were returned to their owners and a new and more complete collection will be placed on exhibition. A large number of duplicate specimens were exchanged during the year and some very valuable foreign specimens were obtained in this way.

EDUCATIONAL COLLECTIONS

Three distinct collections for educational purposes are kept in stock and sold to Canadian schools and educational institutions at less than one-half of what they cost. Grade I collection consists of 144 specimens, $2\frac{3}{4}$ by $2\frac{1}{4}$ inches, of Canadian minerals and rocks, systematically arranged in a small oak cabinet containing five drawers. The price of this collection accompanied by two descriptive cards is \$35 f.o.b. Ottawa.

Grade II collection consists of 44 specimens, $2\frac{1}{2}$ by $1\frac{3}{4}$ inches, placed in a small oak cabinet obtainable for \$12 f.o.b. Ottawa.

Grade III collection is a new one which was prepared for the first time this year. It consists of two drawers containing 44 specimens of rocks, minerals, crystals, and fossils, about $3\frac{1}{2}$ by $2\frac{3}{4}$ inches, intended to illustrate the studies of beginners in geology and mineralogy. A simply worded explanatory pamphlet of twenty-eight pages accompanies the collection, which is sold for \$6, f.o.b. Ottawa.

During the past year 21,660 pounds of mineral specimens were collected by A. T. McKinnon for the above purposes and fifty-five collections containing 2,350 specimens were assembled and shipped to educational institutions.

PALÆONTOLOGICAL DIVISION

E. M. Kindle, Chief of the Division, reports as follows on the year's work:

FIELD WORK

The members of the division have carried on field work in upper Peace River valley, Mackenzie basin, New Brunswick, and Nova Scotia.

E. M. Kindle's field work was limited to a short period during which visits were made to three lakes in the Ottawa valley (Clear, White, and Beauchamp), for the purpose of studying their bottom deposits. Bottom samples were obtained from the marls and other types of bottom deposits forming in these lakes and samples from the peat bogs at Alfred, Ontario, together with data bearing on the explanation of the contrasted types of recent lake deposits now forming. Attention was given also to the factors controlling the distribution and range of fossil-bearing and other concretions in the Ottawa valley.

The field work of F. H. McLarn, E. J. Whittaker, and W. A. Bell is referred to on pages 9 and 11.

C. M. Sternberg visited the locality noted for fossil fishes at Scaumenac bay, N.B., and added many good specimens to the Survey's collection of fishes from that locality. The greater part of the season was spent in collecting fossil stumps and tree trunks from the Coal Measures section at Joggins, N.S. The resulting collection is probably the finest which has ever been made of stumps from the Coal Measures.

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OFFICE WORK

The usual number of special reports on fossils submitted by members of the staff have been furnished by the division.

A special report on the Pleistocene faunas and stratigraphy of Lake Melville basin was prepared at the request of the Department of Justice.

The fossils in the old Museum exhibition and reference series, which were packed hastily when the Survey was asked to vacate the building during the war, were opened, placed in cabinets, and sorted in a preliminary fashion. The assembling of twenty-five sets of fossils for distribution to educational institutions in Canada is one of the miscellaneous pieces of work done by the division during the year.

In research work good progress has been made along several important lines during the year. Mention may be made of W. A. Bell's monograph on the Windsor fauna of the Nova Scotia Carboniferous which is nearing completion.

Mr. Charles W. Gilmore, of the U.S. National Museum, was engaged by the Survey to spend a couple of months on the dinosaur collection. The more interesting and important dinosaur material in our collections which was ready for study has been described by Mr. Gilmore.

Papers on the Alberta Cretaceous floras by Professor Edward W. Berry, and the crinoids of the Mackenzie River valley by Mr. Frank Springer, are among the important palaeontological papers which have been prepared.

EXHIBITS

The museum exhibits of the stratigraphic series of fossils representing southern Ontario were completed during the summer.

The preparation of vertebrate fossils and Coal Measures fossil plants for the Museum exhibits has continued. A start has been made in mounting in the Museum the remarkably fine collection of Coal Measures trees and stumps from the Joggins section in Nova Scotia.

A temporary loan exhibit representing human palaeontology was installed in the Museum during the year by Dr. H. M. Ami. The extensive collection of early human implements and art collected by Dr. Ami from the French caves was included in this exhibit.

DONATIONS

The donations received include a large coral (*Columnaria halli*) from Mr. M. E. Maybee, M.P.; a collection of Mazon Creek, Ill., Coal Measures fossils, from Professor Noe; and a collection of recent shells from Mr. P. B. Symes. Mr. C. J. Kettyle of Endako, B.C., presented to the division a unique collection of concretions from Endako. The large collection of concretions representing all the types of these structures found at the Fulwell Hill quarries, England, was presented to the Survey by Dr. George Abbot of England. Mr. R. R. Hibbard donated a collection of bryozoa, and Dr. C. D. Walcott a small collection of Cambrian fossils.

BORINGS DIVISION

E. D. Ingall, Chief of the Borings Division, reports as follows:

In the Department of Mines Act (6 and 7 Edward VII, Chap. 29), the Geological Survey Branch was entrusted with the work of collecting records of boring operations throughout Canada. The main object kept in view is to acquire all possible geological and economic information made available through boring operations, and to examine samples and keep systematic records which shall be available for the guidance of those engaged in current operations and for all boring ventures and geological studies in the future.

The data sought and collected are mostly drillers' records and sets of samples illustrative of the character of the strata penetrated. Drillers' records—at least, the majority of them—would alone be of little use in the study of the geological problems that call for solution wherever search is made for petroleum, natural gas, water, coal, etc. This is because the drillers are seldom interested in the scientific side of the problem, but chiefly in making rapid progress with their contract. Although they are highly skilled mechanics in their own calling, few drillers have had any occasion to study geology and their records represent the observations of non-technical observers couched in their own language. Hence arises the need for the collection of full and accurately taken sets of samples for the interpretation of the drillers' records in the light thrown upon them by the study of the material thus accumulated. This involves microscopic and chemical tests by methods which have been developed for determining the main constituents of the samples and yet are rapid enough to give the information required by the driller for his guidance during the progress of the operations. Since the samples from a 1,000-foot well may amount to as many as 100 or 200, much time is consumed by even the rapid approximate methods mentioned. Such investigation is thus necessarily limited to selected wells of special geological importance. To apply such methods to all borings in Canada would make prohibitive demands in the matter of staff and equipment.

During the year, the work has been continued along these general lines. Many records have been added to the files of the division and many sets of samples from borings have been accumulated.

The Northwest Territories and Yukon Branch of the Department of the Interior continue to send copies of all logs of wells received by them, as a result of their supervision of the boring operations throughout the Northwest provinces.

The Imperial Oil Company have continued to send copies of logs and sets of samples for their borings in the Northwest provinces and thanks are due to Mr. John Ness of the geological staff of that company for his sympathetic aid. Of special interest is the full set of samples received from the deepest well in Canada bored by this company, viz., Twin Butte No. 2, on sec. 20, tp. 3, range XXIX, west of 5th mer., which attained a depth of 4,370 feet.

A number of gas and oil operators in Alberta and Saskatchewan have furnished important additions to our knowledge of the geological problems involved. The study of these problems, however, primarily rests with the Geological Division of the Survey.

Great interest this year has centred on the Coutts district where a number of wells have been drilled. Information or samples have been received from the following companies: Lethbridge Oils, Border Oils, Coutts-Sweetgrass Oils, Oil Lands Exploration Company, and the Sanctuary Oil Company on Pakowki lake. The sets of samples have not all been as complete as could be desired, and it is to be regretted that more companies in this area have not co-operated with the Department.

A few of the other companies with whom communication has been held are the Community Oils, whose geologist, Mr. Roy Lebkicker, has been most helpful in discussing the geology of that area; the West Regent Oil and Development Company, who have been drilling a deep well on sec. 19, tp. 34, range IV, west of 4th mer., to a depth of 3,325 feet; the British Petroleum Company north of Wainwright, Irma Oil Holdings, and the Medicine Hat Petroleum, Limited.

Thanks to the co-operation of Mr. H. F. Ratheram, in charge of the Manitoba government boring at Winnipegosis, a full set of samples has increased our knowledge of the Palaeozoic sedimentary series and the full section has been

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established down to the underlying Precambrian. This information will be of value as to future borings for gas or oil in the Devonian, Silurian, and Ordovician series that underlie the Cretaceous in the western provinces. These formations have yielded petroleum and natural gas elsewhere on this continent, and they may contain these minerals at other places. It is to be regretted that this Well-drilling Branch of the Department of Public Works in Winnipeg, of which Mr. Ratheram was superintendent, had to be closed down. Being on the ground, the officials were able to collect a large number of logs of wells drilled all over Manitoba, most of which information was furnished to the Borings Division.

Thanks to the co-operation of the officials of the Stony Mountain Oil Company and to D. F. MacDougall of the Mafeking boring, and to others, a better understanding is being acquired of the geology of the zone of country along the eastern escarpment of the Cretaceous in Manitoba and of the Palaeozoic underlying the country surrounding lakes Manitoba, Winnipeg, and Winnipegosis.

Our knowledge of the gas and oil fields of the Interlake peninsula is being constantly enlarged through work done in co-operation with Col. Harkness, the Provincial Gas Commissioner. Cores were received from shallow test borings put down on the east bank of Mattagami river above Pike creek, in search for petroleum. Samples received from a deep well near Fort William gave much needed data regarding the character of the flat-lying strata of that region in their extension southerly in depth from their surface outcrops.

Two borings of which complete information was received were put down between Pointe Fortune, Ontario, and Carillon, Quebec, to test the foundation for a dam; and from the Government Experimental Farm boring at Cap Rouge, Que., to which a visit was made to study the conditions for a water supply.

Samples were sent from a boring near Truro, N.S., prosecuted by Messrs. Kent and Kennedy, boring contractors, and from the boring put down by the New Brunswick Cold Storage Company at St. John, N.B. These samples throw further light on the character of the strata in depth. The New Brunswick Gas and Oil Fields Company have continued to send sets of samples from their wells.

An attempt has been made with gratifying results to enlist the help of officials of other departments of the Federal, as well as of the Provincial governments.

Advice is constantly asked for and given in regard to obtaining water by boring. In the Ottawa district, it was found possible to gain information from several new wells, thus enlarging our knowledge of this district. The problems of water supply have been studied in other parts of Canada. A number of well drillers have assisted us in this way by supplying us with data as to shallow wells and have responded by filling in our questionaries. Among others may be mentioned the Canadian Well Supply Company, Messrs. W. T. Crowly, D. Collins, W. H. Mauch, and J. C. Maines, all in the drilling business in Regina, Sask.

Samples and Records Received, 1922

	Number of samples received	Number of wells from which samples were received	Number of records received
Maritime Provinces.....	1,134	10	37
Quebec.....	55	2	6
Ontario.....	4,578	39	63
Northwest Provinces.....	2,083	26	177
British Columbia.....	125	4	5
Total.....	7,975	81	288

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GEOGRAPHICAL AND DRAUGHTING DIVISION

C.-Omer Senécal, Chief of the Division, reports as follows:

No change has taken place in the staff, two vacancies of senior map draughtsmen still remaining to be filled by the Civil Service Commission. The work has been carried on by the Chief of the Division, three principal map draughtsmen, three seniors, one engraver, and two clerks, as outlined in last year's report.

Twenty-two new maps have been published; thirteen are at present in the hands of the King's Printer for lithographing and printing; the engraving on copper of five is completed or in progress; and thirty-six other maps are at various stages of progress in the office.

The general map of north eastern Ontario, on the scale of 1 inch to 8 miles, referred to in last year's report, has been completed and sent out for printing. The base of the map of the adjacent part of western Quebec has also been completed, but awaits data from the geologist, before final preparation for publication can be proceeded with.

Several large-scale geographical maps were compiled for use by geologists in the field, and to serve as bases for future geological maps. These compilations include areas in Timiskaming and Gaspe counties, Quebec.

A special standard stipple for use in representing as uniformly as possible, drift-covered areas on geological maps, has also been engraved on copper.

Owing to illness of the geologist in charge of Nova Scotia serial sheets, little progress was made in the compilation of new surveys of Queens and Shelburne counties; two sheets, however—Vogler Cove, No. 90, and Chester Basin, No. 87, Lunenburg county—have been engraved.

One hundred and twelve zinc-cut and other drawings of sketch maps, text-figures, diagrams, etc., were executed for the illustration of memoirs, bulletins, and reports, and for sundry purposes.

Steady progress was made in the cataloguing of field books and other survey records kept in this division.

Duties in connexion with the Geographic Board of Canada were, as usual, attended to.

A list of maps remaining in the hands of the King's Printer and in the Engraving Division, on March 31, 1923, and a list of maps published during the fiscal year, are appended herewith:

**Maps in Hands of King's Printer and in Engraving Division,
March 31, 1923**

Publication number	Title	Date of requisition	Remarks
1963	Arctic coast of Canada between Darnley bay and Bathurst inlet, Mackenzie district, N.W.T.; scale, 1 inch to 10 miles.....	Feb. 8, 1923	Can. Arctic Exp., 1913-19
1977	Mackenzie river between Norman and Beaver river, Mackenzie district, N.W.T.; scale, 1 inch to 8 miles..	Feb. 28, 1923	Geology
1961	Barkerville area, Cariboo district, B.C.; scale, 1 inch to 1 mile.....	Aug. 8, 1922	Geology
1962	Palliser-Kananaskis area, B.C. and Alta.; scale, 1 inch to 2 miles.....	Aug. 29, 1922	Topography Copper engraving completed
1897	Coquihalla area, Yale district, B.C.; scale, 1 inch to 1 mile.....	Nov. 20, 1921	Topography Copper engraving in progress
			Copper engraving completed

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Maps in Hands of King's Printer and in Engraving Division, March 31, 1923—Continued

Publication Number	Title	Date of requisition	Remarks
1988	Coquihalla area, Yale district, B.C.; scale, 1 inch to 1 mile.....	Mar. 1, 1923	Geology Copper engraving in progress
1980	Upper Elk and Upper Highwood rivers, B.C. and Alta.; scale, $\frac{1}{256,000}$	Mar. 23, 1922	Geology
1933	Fraser River delta, B.C.; scale, 1 inch to 1 mile.....	Feb. 7, 1922	Topography
1965	Fraser River delta, B.C.; scale, 1 inch to 1 mile.....	Nov. 20, 1922	Geology
1979	Artesian area, southern Alberta; scale, 1 inch to 6 miles.....	Feb. 27, 1923	Geology
1978	Part of the Flinflon group of claims, Man. and Sask.; scale, 1 inch to 250 feet.....	Jan. 26, 1923	Geology
1553	Portions of Algoma, Sudbury, and Timiskaming districts, Ont.; scale, 1 inch to 8 miles.....	May 1, 1922	Geology
1972	Michipicoten area, Algoma district, Ont.; scale, 1 inch to 1 mile.....	Feb. 6, 1923	Geology
1982	Sagamité peat bog, Quebec county, Que.; scale, 1 inch to 2,400 feet.....	Feb. 27, 1923	Economic geology
1983	Breakyville peat bog, Levis county, Que.; scale, 1 inch to 2,400 feet.....	Feb. 27, 1923	Economic geology
1984	St. Jean peat bog, Levis county, Que.; scale, 1 inch to 2,400 feet.....	Feb. 27, 1923	Economic geology
1960	Vogler Cove, sheet No. 90, Lunenburg county, N.S.; scale, 1 inch to 1 mile.....	Sept. 8, 1922	Geology Copper engraving completed
1981	Chester Basin, sheet No. 87, Lunenburg county, N.S.; scale, 1 inch to 1 mile.....	Jan. 12, 1923	Geology Copper engraving in progress

Maps Published April 1, 1922, to March 31, 1923

Publication number	Title	Remarks
YUKON TERRITORY		
1937	Rambler Hill area, Mayo district; scale, 1 inch to 2,000 feet.....	Geology. In report by W. E. Cockfield, part A, Summary Report, 1921
1940	Mount Cameron area, Mayo district; scale, 1 inch to 2,000 feet.....	" "
1943	Stand-to Hill area, Mayo district; scale, 1 inch to 2,000 feet.....	" "
MACKENZIE DISTRICT, N.W.T.		
1585	Mackenzie River basin; scale, 1 inch to 50 miles.....	Geology. Third revised edition. In part B, Summary Report, 1921
1956	Mackenzie river, Great Slave lake to Simpson; scale, 1 inch to 8 miles.....	Geology. In report by E. J. Whittaker, part B, Summary Report, 1921
1957	Mackenzie river, Simpson to Wrigley; scale, 1 inch to 8 miles.....	" "
BRITISH COLUMBIA		
1882	Bridge river (Rexmount to Gull lake), Lillooet district, B.C.; scale, $\frac{1}{256,000}$	Geology and topography. In Memoir No. 130, by W. S. McCann
1941	Part of Antler creek, Cariboo district; scale, 1 inch to 1,000 feet.....	Geology. In report by W. A. Johnston, part A, Summary Report, 1921
1942	Part of Williams creek, Cariboo district; scale, 1 inch to 1,000 feet.....	" "
1945	North Thompson valley, Joseph creek to Louis creek, Kamloops district; scale, 1 inch to 200 feet.....	Geology. Preliminary map in report by W. L. Uglow, part A, Summary Report, 1921

Maps Published April 1, 1922, to March 31, 1923—Continued

Publication number	Title	Remarks
ONTARIO		
1926	Kenogami Lake area, Timiskaming district; scale, 1 inch to 1 mile.....	Geology. In Memoir 131, by H. C. Cooke
1927	Round Lake area, Timiskaming district; scale, 1 inch to 1 mile.....	" "
1932	Larder Lake area, Timiskaming district; scale, 1 inch to $\frac{1}{2}$ mile.....	" "
1936	Shields, Gaudette, Deroche, and Hodgins townships, Algoma district; scale, 1 inch to 1 mile.....	Geology. In report by S. Brunton, part D, Summary Report, 1921
1948	Wanapitei Lake area, Sudbury district; scale, 1 inch to 1 mile	Geology. In report by T. T. Quirke, part D, Summary Report, 1921
1951	Verona peat bog, Camden-East and Portland townships, Lennox, Frontenac, and Addington counties; scale, 1 inch to 2,400 feet.....	Economic geology. In report by A. Anrep, part D, Summary Report, 1921
1952	Twin Cities and William peat bogs, Thunder Bay district; scale, 1 inch to 2,400 feet.....	Economic geology. In report by A. Anrep, part D, Summary Report, 1921
1953	Arthur peat bog, Paipoonge township, Thunder Bay district; scale, 1 inch to 2,400 feet.....	" "
1964	Brockville-Mallorytown area, Leeds county; scale, 1 inch to 1 mile.....	Geology. In Memoir 134, by J. F. Wright
QUEBEC		
1935	Part of Lemieux township, Gaspe county; scale, 1 inch to 4,000 feet.....	Geology. In report by F. J. Alcock, part D, Summary Report, 1921
NEW BRUNSWICK		
1239	Moncton area, Westmorland and Albert counties; scale, $\frac{1}{62,500}$	Geology and topography. In Memoir 129, by W. J. Wright
NOVA SCOTIA		
1767	Sydney, Cape Breton county; scale, 1 inch to 1 mile.....	Geology and topography. In Memoir 133, by A. O. Hayes and W. A. Bell. A limited number of copies were printed without geological colours

MAP ENGRAVING DIVISION

Robert Veitch, in charge of the Map Engraving Division, reports as follows:

Maps Completed

Topographical map, Fraser River delta, British Columbia; scale, 1 inch to 1 mile. Engraved for reproduction in three colours, black, blue, and brown. The area covered by this map necessitated the engraving of the map in two sections, six plates in all being engraved.

Geological map, Fraser River delta, British Columbia; scale, 1 inch to 1 mile. Two plates engraved.

Topographical map, Barkerville area, Cariboo district, British Columbia; scale, 1 inch to 1 mile. Engraved for reproduction in three colours; three plates engraved.

Topographical map, Palliser-Kananaskis area, British Columbia and Alberta; scale, 1 inch to 2 miles. Engraved for reproduction in three colours; three plates engraved.

Topographical map, Clearwater river and Foghorn creek (North Thompson valley), Kamloops district, British Columbia; scale, 1 inch to 1 mile. Engraved for reproduction in three colours; three plates engraved.

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Geographical and topographical map, Arctic coast of Canada, District of Mackenzie, Northwest Territories, with insets of Bernard harbour, and Mackenzie delta and Arctic coast of Yukon Territory; scale, 1 inch to 10 miles. The area covered by this map necessitated the engraving of the map in two sections; two plates being engraved.

Topographical and geological map, Vogler Cove sheet (Nova Scotia series); scale, 1 inch to 1 mile. One plate engraved.

Topographical and geological map, portions of Algoma, Sudbury, and Timiskaming, Ontario; scale, 1 inch to 8 miles. Final revision to four plates carried out.

Manitoba Postal map. Revision to six plates. This work was executed for Post Office Department.

The laying down of offsets necessary for the engraving of the following geological maps:

Sydney, Cape Breton county, Nova Scotia; offsets from three plates.

Coquihalla River area, Yale, British Columbia; offsets from six plates.

Upper Elk and Upper Highwood rivers, British Columbia and Alberta; offsets from three plates.

Standard "Stipple Plate" prepared. Two offsets laid down.

Maps in Progress

Topographical and geological map, Chester Basin sheet (Nova Scotia series); scale, 1 inch to 1 mile. One plate.

Topographical map, Chu Chua Creek sheet (North Thompson valley), Kamloops district, British Columbia; scale, 1 inch to 1 mile. Three plates.

Topographical map, Louis Creek sheet (North Thompson valley), Kamloops district, British Columbia; scale, 1 inch to 1 mile. Three plates.

PHOTOGRAPHIC DIVISION

G. G. Clarke, Chief Photographer, reports that the following work was done by this division during the year:

	Inches	Inches	Number
Contact prints.....	4 by 5 to 36	by 48	13,834
Bromide enlargements.....	4 " 5 "	40 " 72	745
Exposures developed.....	3 $\frac{1}{4}$ " 4 $\frac{1}{4}$ "	6 $\frac{1}{2}$ " 8 $\frac{1}{2}$	4,678
Dry plate negatives.....	4 " 5 "	11 " 14	467
Wet plate negatives.....	8 " 10 "	24 " 30	148
Prints on zinc.....	11 " 14 "	24 " 36	43
Photostat copies.....	7 " 11 "	11 " 14	93
Lantern slides.....	3 $\frac{1}{4}$ " 4		831
Photographs and titles mounted.....			803
Total.....			21,642

The Geological Survey collection of photographs now comprises 56,000 negatives. These pictures have been accumulated by officers of the Survey chiefly during the last fifty years and are representative of all parts of Canada, and from the United States boundary to the Arctic ocean. They cover an extraordinary range of interesting subjects and many of the older ones have now acquired historical value as records of the progress and development of the country. In order to make this collection more available to the public a set of photographic prints, mounted and classified according to subjects, is being prepared and placed in the Geological Survey library. An arrangement has also been made whereby, as time permits, photographic prints, enlargements, and lantern slides will be made on request from persons outside the Department at about the cost of preparation. Advance photographic copies of maps, photostat reproductions of pages from rare reports, and other work of the kind will also be done. This work for the public will be subordinated to the official photographic work for the Department of Mines and will be executed in an amount dependent upon the resources of the Photographic Division.

A collection of photographs illustrative of physiographic forms in Canada, which was undertaken eight years ago, is being continued. This collection is of particular interest to Canadian universities and other institutions engaged in the study and teaching of physiography, as well as being of considerable popular interest. The collection is on view in the library of the Geological Survey and photographic prints, enlargements, or lantern slides of any of the photographs may be purchased.

GEOLOGICAL INFORMATION AND DISTRIBUTION DIVISION

Wyatt Malcolm, Chief of the Division, reports as follows:

The work of the division consists in giving information regarding the geology and mineral resources of Canada. This information is imparted verbally to men making application in person, and is given out in the form of correspondence, memoranda, and published reports and maps. A large part of the technical correspondence of the Geological Survey is dealt with. Articles were prepared during the year for publication in the Gazette, Industrial Canada, the Canada Year Book, and the Canadian Mining Journal.

It is a matter of great satisfaction to the Geological Survey and to the public that the field work of the Survey, although not as extensive as could be desired on account of the smallness of the staff, has been so directed as to embrace many of the most important areas and thus enable the constant demand for maps and reports on mining districts and centres of prospective mineral possibilities to be met. The foresight of the administration in anticipating the demand for information regarding the geology of that part of Quebec lying east of the gold-producing area of northeastern Ontario has made it possible during the year to place in the hands of prospectors, geologists, and engineers maps and reports that have been declared to be of great monetary value. The report of a discovery of silver minerals on Red lake, Ontario, created a big demand for publications on this area, which, owing to earlier investigations, the Department was able to supply. A report on southern Alberta, with accompanying map and diagrams, was also available for distribution to great numbers whose interest in the oil possibilities of this area was roused by the opening of a commercial field a few miles south of the border.

These are but a few instances of the ways in which demands for information have been met by supplying publications on definite areas. In many cases information has been supplied that has been obtained through the accumulated results of investigations carried on for a series of years or through decades of field work. It is only as a result of long continued field work that clear and positive statements can be made regarding the possibility of obtaining coal in Ontario and Quebec.

The distribution of the publications of the Geological Survey and of the Victoria Memorial Museum is made by this division. During the year 64,458 publications, exclusive of the French editions, were distributed. Of these 13,458 were sent to addresses on the mailing lists and 51,000 were distributed in compliance with written and personal requests for named publications or requests for general or specific information.

LIBRARY

Mrs. F. E. Forsey, Librarian, reports that the library of the Geological Survey now contains over 50,000 volumes, including all the more important scientific and technical publications that deal with the subjects of concern to the Survey and the Museum.

The additions to the Library during the year include:

Volumes received as gifts or exchanges.....	534
Books purchased.....	685
Pamphlets and Government publications.....	2,324
Periodicals subscribed for.....	166
Periodicals received as exchanges.....	106
Maps received.....	241

The number of volumes bound was 411, which included 34 monographs of the Palaeontographical Society, and 20 volumes of Paléontologie Française; 103 maps were mounted. The record of readers and visitors is 5,029, of books

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borrowed 3,065, and cards added to the catalogue 2,929. A large amount of reference work was done by the library staff, and several bibliographies prepared for other government departments, and individual scientific workers. Frequent calls are received from outside libraries for the loan of publications known to be available only in this library, such as rare governmental reports on geology, foreign technical and scientific publications, and foreign maps. The Library now has almost complete sets of the publications of one hundred and six Geological Surveys, comprising fifty-two in North and South America (including that of Greenland), eight in Australia and New Zealand, twelve in Africa, nine in Asia, and twenty-five in Europe. These, with the transactions and proceedings of most of the important museums and learned societies of the world, make this one of the best equipped and most comprehensive research libraries in Canada.

Considerable progress was made during the year in cataloguing the collections of photographs, maps, and lantern slides; 560 slides on geology, palaeontology, and geographical subjects being labelled and catalogued. These have been in constant use during the winter months, not only by members of the Survey staff, but as loans to schools and other institutions. Students, and workers in other departments, frequently consult our maps, and the photograph collection is proving its usefulness, particularly as a source of illustration for bulletins and articles on Canadian resources. As an instance, the "Report of the Royal Commission on Reindeer and Musk-ox Industries in the Arctic Regions" contains no less than thirteen illustrations selected from the photographs filed in the Library.

Among the recent notable additions to the Library are the following:

Journal of the Boston Society of Natural History, complete set of 7 volumes.

Linnean Society of London, Zoology, 34 volumes, 1857-1922.

Geological Society of France, Mémoires:

Geology, 15 volumes,

Palaeontology, 20 volumes.

Reichenbach's Icones Flora Germanicae et Helveticae, 19 volumes, 1834-1867.

Norske Nordhav Expedition, 1876-78.

Voyage of the Belgica, 49 parts, 1897-98.

Magazine of Natural History, ed. by Loudon,
vol. 1-9, 1829-36; ed. by Charlesworth,
vol. 1-4, 1837-40.

Preussische Geologische Landesanstalt:

Abhandlungen, 23 volumes,

Jahrbücher, 17 volumes.

Revista di Antropologia, Rome, 15 volumes.

Geologische Gesellschaft in Wien, Mitteilungen, 8 volumes.

Académie Royale des Sciences et des Lettres, Copenhagen, 26 volumes.

Nyt Magazin for Naturvidenskaberne, Christiania, 67 volumes.

Botanisk Tidsskrift, Danish Botanical Society, 23 volumes.

Beiträge zur Paläontologie und Geologie Österreich-Ungarns und des Orients, 13 volumes.

Journal of Botany, British and Foreign, vol. 1-59, 1863-1921.

VICTORIA MEMORIAL MUSEUM

William McInnes, Director

The officers of the Biological Division of the National Museum, which includes mammalogy, ornithology, and botany, and of the Anthropological Division which includes archaeology, in addition to the work necessary for the upkeep and improvement of the exhibits in the public exhibition halls, have devoted their time to research work in the various fields indicated by their titles.

R. M. Anderson, besides administering the division as chief, has been engaged in a special investigation of the life histories and habits of the mammals of Quebec, as a part of a larger study of the same subject covering the whole of Canada.

In like manner, Mr. Taverner has given his time to the study of the birds of western Canada, particularly for the purpose of securing data for a memoir on the western birds similar in general character to the work on the eastern birds which has recently been published in a second edition.

M. O. Malte has been making an intensive examination of the flora of the Ottawa region with the object of publishing a detailed botanical description of that region.

Clyde Patch, besides his work as chief taxidermist, has given his attention to Canadian reptiles and amphibia, and the staff of preparators have been continuously employed in the duties of their several positions as set forth in Mr. Anderson's report on the work of the Biological Division.

The work of the Anthropological Division is described in detail in Mr. Sapir's report, which follows on later pages.

The course of free public lectures, on Saturday mornings for children and on Wednesday evenings for adults, was continued during the winter from December to March, under the supervision of Mr. D. B. Dowling and Mr. Harlan I. Smith. The lectures were provided from the staffs of the Department and of the Canadian National Parks Branch of the Department of the Interior, and the lectures were illustrated by stereopticon views; and, through the courtesy of the Department of Trade and Commerce, by moving pictures.

The Saturday morning lectures for children were specially popular, and as they deal with the natural resources of Canada and its natural history and anthropology, are of recognized educational value.

The following lectures were included in the courses, both for adults and children:

Where Animals Go in the Winter Time, by Clyde L. Patch, Victoria Memorial Museum.
 The Ups and Downs of a Topographer's Life, by E. E. Freeland, Topographical Division, Geological Survey.
 Sight-seeing at Banff and Lake Louise, by M. F. Bancroft, Geological Survey.
 The Iroquois as Warrior, Agriculturist, and Hunter, by F. W. Waugh, Victoria Memorial Museum.
 Bird Protection in Canada, by Hoyes Lloyd, Canadian National Parks Branch.
 Museum Work, by Harlan I. Smith, Victoria Memorial Museum.
 A Trip Through The Pas Mineral Belt, by F. J. Alcock, Geological Survey.
 Animals of the Past, by Charles M. Sternberg, Geological Survey.
 Snakes, by Clyde L. Patch, Victoria Memorial Museum.
 The Forests of British Columbia, by M. F. Bancroft, Geological Survey.
 Canada's National Playgrounds, by J. B. Harkin, Commissioner of Dominion Parks, Department of the Interior.
 The Yukon, by W. E. Cockfield, Geological Survey.
 The Ojibwa, a Typical Migratory Hunting Tribe, by F. W. Waugh, Victoria Memorial Museum.
 Folk Songs of Canada, by C. M. Barbeau, Victoria Memorial Museum.

The Auditorium was also in great demand by scientific, literary, and other societies, and was occupied on fifty evenings in addition to those taken up by the Museum lecture course.

Although the exhibits in the Museum are continually being augmented and improved, the need for greater space becomes more and more apparent, and until this is provided the exhibits must fall short of our conception of a truly National Museum of Canada.

ANTHROPOLOGICAL DIVISION

ETHNOLOGY AND LINGUISTICS

Exhibits and Research

E. Sapir, Chief of the Division, reports:

The anthropological exhibits in the Victoria Memorial Museum have been added to and to some degree rearranged and relabelled. The need of adequate space for exhibits and of cases for their proper installation, is still greatly felt.

Six scientific field trips were undertaken in the course of the year: a trip by E. Sapir among the Sarcee Indians of Alberta, mainly for linguistic research; another by H. I. Smith, archaeological and ethnological, among the Bella Coola Indians of British Columbia; one by C. M. Barbeau for research in French folklore, in Gaspe and Bonaventure counties, Quebec; the latter part of F. W. Waugh's trip to the Nascopi Indians of northern Quebec and the Eskimo of the Labrador coast; the continuation of W. J. Wintemberg's archaeological exploration of a site near London, Ontario; and the latter part of an ethnological trip by T. F. McIlwraith to the Bella Coola Indians, British Columbia.

E. Sapir spent two months at Sarcee Reserve, near Calgary, Alberta, in a detailed study of the language of the Sarcee Indians, which belongs to the Athabaskan (or Déné) group of languages. A series of mythological and ethnological texts was obtained, also a large body of explanatory grammatical data. A certain amount of ethnological work proper was also done, notably on kinship terms, personal names, and design symbolism. Upwards of two hundred Sarcee and other Plains Indian specimens and a number of photographs supplement similar material obtained by Mr. Jenness during the preceding year. In the office Mr. Sapir continued work on the "Nootka Texts (Tales and Ethnological Narratives)," previously reported on; this volume is now almost complete. A volume of "Tales of the Sarcee Indians (Texts and Translations)," is also being prepared; this will probably be published by the American Ethnological Society. Much work was done on Nootka and Sarcee grammar. In connexion with the latter a paper was read on "Pitch Accent in Sarcee, an Athabaskan Language," before the annual December meeting of the American Anthropological Association, at Cambridge, Mass. Linguistic and ethnologic papers published during the year embrace: "The Fundamental Elements of Northern Yana" (University of California Publications in American Archaeology and Ethnology, vol. 13, pp. 215-234); "A Characteristic Penutian Form of Stem" (International Journal of American Linguistics, vol. 2, pp. 58-67); "A Supplementary Note on Saliman and Washo" (*ibid.*, pp. 68-72); and "Vancouver Island Indians" (sketch of Nootka religion in James Hastings' "Encyclopaedia of Religion and Ethics," vol. XII). Two papers of more general cultural interest, "Culture, Genuine and Spurious" and "Culture in New Countries," appeared in The Dalhousie Review for July and October, 1922. A number of linguistic and ethnological papers, to be published by the University of California, the Journal de la Société des Américanistes de Paris, and the International Journal of American Linguistics, were seen through the press.

H. I. Smith spent the summer season in a third visit to the Bella Coola Indian area, continuing the combined archaeological and technological work of his previous trips. Supplementary Bella Coola and Carrier specimens were obtained and numerous photographs taken. In the office Mr. Smith continued

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work on his reports upon the material culture, past and present, of the Bella Coola and Carrier Indians.

C. M. Barbeau spent four months in investigating the French folk-lore of Gaspe and Bonaventure counties, Quebec. This trip was followed up by library research in New York and Washington for the purpose of finding European parallels to the French folk-songs of Canada. In the course of the year Mr. Barbeau prepared a report on the potlatch among the natives of British Columbia; this was for the use of the Department of Indian Affairs.

D. Jenness spent the summer of 1922 in preparing a second report on the ethnological results obtained by him when serving as ethnologist on the Canadian Arctic Expedition. This report, entitled "The Physical Characteristics of the Copper Eskimos," was sent to press at the end of the year, and will shortly be issued. At the end of December he attended the meetings of the Anthropological Section of the American Association for the Advancement of Science in Cambridge, Mass., and read a paper on "The Origin of the Copper Eskimos." During the latter part of the fiscal year Mr. Jenness was occupied with the revision and editing of a lengthy report on "The Social Life of the Miemac and Malecite Indians," prepared for the department several years ago by W. H. Mechling.

F. W. Waugh spent the period from April 1 to nearly the end of July, 1922, among the Labrador Eskimo who live in and around Nain. From an old woman found at this point who came from Hebron, over 200 miles farther north, and from other informants, a considerable amount of material was obtained on Eskimo foods, handicrafts, folk-lore, ancient religious beliefs, amusements, and a number of other ethnological subjects. Photographs were taken from time to time, illustrating such pursuits as fishing, hunting, house-building, travelling by dog-team, and komatik-making. In the office Mr. Waugh continued work on his collection of over one hundred and seventy-five "Myths and Tales of the Iroquois."

T. F. McIlwraith spent five months investigating the social and religious life of the Bella Coola Indians. He collected information concerning their fluid, but complicated, system of rank and government, which depends largely on the transmission of ancient names. Marriage practices and death rites are closely bound up with this system. Religious beliefs and rituals were investigated, accounts obtained of some thirty ceremonies, and a large number of myths collected. Many of these were of especial value as records of what the Indians believed to be the early history of their people. From August to February Mr. McIlwraith was employed in reducing this material to manuscript form. Field notes were typed out and the whole placed under headings. A cross-index was prepared, so that the material is now available as a basis for further investigations and for publication.

In the course of the year there were published in the *Journal of American Folk-Lore* (vol. XXXIV, 1921, pp. 223-253, 335-356) the third and fourth installments of the late J. A. Teit's "Tahltan and Kaska Tales," material originally obtained for the division; these issues complete the mythological part of Mr. Teit's Tahltan and Kaska field data. Two reports on the physical anthropology of the Eskimos are now in press: "The Physical Characteristics of the Western and Copper Eskimos," by D. Jenness, and "The Osteology of the Western and Central Eskimos," by Prof. J. Cameron; both of these are to appear in the reports of the Canadian Arctic Expedition.

Ethnological manuscripts secured during the year embrace:

Two Nootka manuscripts, mostly in text and translation, on puberty and mourning potlatches inherited privileges, death and burial, religious beliefs, and social organization; from Alex. Thomas, Alberni, B.C.

"Notes on the Port Simpson Tsimshian"; from Wm. Beynon, Port Simpson, B.C.

*Accessions**Accessions of Ethnological Specimens*

Specimens collected in course of field work by members of the Division of Anthropology include:

By E. Sapir:

- 215 Sarcee specimens from Sarcee Reserve, Alta.
- 7 Western Cree specimens from Sarcee Reserve.
- 9 Stoney specimens from Sarcee Reserve.
- 3 Blackfoot specimens from Sarcee Reserve.
- 4 Chipewyan specimens from Sarcee Reserve.

By H. I. Smith:

- 67 Carrier specimens from Bella Coola, B.C.
- 76 Bella Coola specimens from Bella Coola, B.C.

By F. W. Waugh:

- 7 Labrador Eskimo specimens from Nain, Labrador (1921-22).
- 19 Naskopi Indian specimens from Voisey bay (near Nain), Labrador (1921-22).

By T. F. McIlwraith:

- 41 Bella Coola specimens from Bella Coola, B.C.

There have been received as gifts:

From M. W. Marvin, Atnarko, B.C.:

Tip for salmon spear from camp of Carrier Indians from Ulkatcho, B.C.

From G. S. Hume, Geological Survey, Ottawa:

- 1 draw-knife for dressing skins from S. Nahanni Indians.

Accessions Received in Physical Anthropology

Gifts include:

- Part of skeleton found on lot 17, concession II, London township, Middlesex county, Ontario, presented by Richard Payne, London, Ont., October, 1921.
- Part of human skull and lower jaw from a grave on the farm of George Leslie, lot 23, concession III, Mt., Hallowell township, Prince Edward county, Ontario, presented by George Leslie, Picton, Ont., Feb. 23, 1923.

Skeletal material obtained in the course of field work in archaeology includes:

- 2 trepanned human skulls from southwest British Columbia, collected by H. I. Smith (see report on Archaeology).
- Skull from the Lawson village site, Middlesex county, Ont., collected by W. J. Wintemberg.

Photographic Work

Ethnological photographs taken or collected for the Museum by officers connected with the Division of Anthropology:

By E. Sapir:

- 64 Sarcee photographs from Sarcee Reserve, Alberta.

By H. I. Smith:

- 193 Bella Coola photographs from Bella Coola, B.C.
- 60 Carrier photographs from Bella Coola, B.C.
- 10 Chilcotin photographs from Bella Coola, B.C.
- 1 Squamish photograph from S.W. British Columbia.

By F. W. Waugh:

- 9 Montagnais photographs from Labrador.
- 29 Naskopi photographs from Labrador.
- 225 Labrador Eskimo photographs from Labrador.

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There have been received as gifts from individuals not connected with the Division of Anthropology:

From Capt. J. Bernard:

59 Chukchee and Alaskan Eskimo photographs from E. Siberia and neighbourhood.

From the American Museum of Natural History:

Cinema print of Bella Coola Indian life.

Lantern slides made in the course of the year by the Photographic Division for the Division of Anthropology include:

62 lantern slides illustrating Canadian Indian art.

10 lantern slides illustrating Canadian Indian Art were made for the Department of Education of the Provincial Government of B.C.

FOLK-LORE

C. M. Barbeau, Ethnologist, reports:

The bulk of the folk-lore data in the past year was collected in the course of an extensive summer investigation carried on by C. M. Barbeau in Bonaventure and Gaspe counties, where the French-speaking population is largely of Acadian, Jersey, and Guernsey extraction. A volume of French-Canadian folk-songs, including historical comments and metrical translations, has been nearly completed by E. Sapir and C. M. Barbeau in collaboration.

Folk-lore Collections

(French)

The Barbeau (C. Marius) Collection:

600 song texts collected in Bonaventure and Gaspe counties (Port Daniel, Gascons, Rivière-aux-Renards, etc.).

312 song melodies recorded on the phonograph.

600 (approx.) photographs of people, buildings, etc., in Gaspe and Bonaventure counties.

Various other data on the population and folk-lore of the same counties.

The Massicotte (E.Z.) Collection:

300 (approx.) photographs of buildings, people, ancient designs, and artifacts of Montreal and neighbouring counties.

14 song texts recorded in Montreal.

The Clouthier (Dr. J. E. A.) Collection:

10 manuscript pages of "blason populaire" of L'Islet county

The Lambert (Adélard) Collection:

2 folk-tales.

5 folk beliefs.

The Lanciôt (Gustave) Collection:

2 song texts.

Totals of the year:

676 song texts.

312 phonograph records of song melodies.

900 (approx.) photographs.

2 folk-tales.

The "blason populaire" of L'Islet county.

Various other data.

(English)

The Wintemberg (W. J.) Collection:

37 items (sayings, beliefs, etc.) from the neighbourhood of Buffalo (N.Y.).

Also some data on Canadian negro folk-lore, divination, omens, etc.

ARCHÆOLOGY

Harlan I. Smith, Archæologist, reports:

The archæological exhibits have remained open to the public during the year. About half of them have been rearranged and relabelled.

Accessions

The accessions to the archaeological collections are as follows:

Collected by Officers of the Division

Accession 258. Archaeological specimens. From Lawson farm site, London township, Middlesex county, Ontario. Collected by W. J. Wintemberg.

Accession 262. Archaeological specimens, plaster of Paris moulds of petroglyphs, and photographs. From British Columbia. Collected by Harlan I. Smith.

Accession 264. Archaeological specimens. From Bella Coola, B.C. Collected by T. F. McIlwraith.

Gifts

Accession 259. Fragment of Algonkian pottery. From Lobo township, Middlesex county, Ont. Presented by Percy B. Seabrook, Komoka, Ont.

Accession 260. Grooved hammer from Pass creek, Waterton park, Alberta. Presented by G. Bevan, Waterton park, Alberta, through Charles H. Young.

Accession 261. Two carved prongs of elk antler. From shell-heap on west shore of Boundary bay, east side of Point Roberts, Washington. Presented by M. H. Whalen, Point Roberts, Washington, through Harlan I. Smith.

Accession 263. Archaeological material. From near Eganville, Renfrew county, Ontario. Presented by Dr. James Reeves, Eganville, Ontario.

Accession 265. Fragments of pottery. From prehistoric ruin, Cornfields, Ganado, Arizona. Presented by A. B. Regan, Cornfields, Ganado, Arizona.

Accession 266. Archaeological specimens. From near Picton, Prince Edward county, Ontario. Presented by George Leslie, Picton, Ontario, through J. P. Williams, Picton, Ontario.

Accession 267. 2 stone gouges, one from Picton, Prince Edward county, Ontario, the other from Hillier township, Prince Edward county, Ontario. Presented by F. P. Smith, Inspector of Public Schools, Picton, Ontario.

Accession 268. Pottery pipe, found in the ruins of Fort Carleton, Carleton island, St. Lawrence river, opposite Kingston, 1875. Presented by Dr. Alfred J. Horsey, Ottawa, Ontario.

Field Work

Archaeological exploration was carried on in British Columbia by Harlan I. Smith and in Ontario by W. J. Wintemberg.

British Columbia. Archaeological exploration in British Columbia was conducted by Mr. Smith in the Bella Coola Indian area, in continuation of the work of the past two field seasons, and in the vicinity of Vancouver. Twenty-seven plaster of Paris moulds and three photographs were made of petroglyphs near Bella Coola and some archaeological specimens were collected. Four photographs were made of red pictographs, supposedly made in ancient times by Carrier Indians on a rock cliff over a cave at the mouth of the Atnarko valley. The site of the ancient Bella Coola Indian village mentioned by MacKenzie, the first white man to cross Canada, and marked on his map as the "Friendly Village," was located and examined.

South of Vancouver several shell-heaps or middens of ancient Indian villages were visited in order to secure evidence of their antiquity. Village accumulation over 9 feet deep in one of these heaps and a Douglas fir stump, which exhibited over four hundred and twenty rings of annual growth, standing on it, were photographed. This heap is about a mile from the present seashore, but at the time it was formed was probably accessible by sea canoes.

The sculptured human form collected last year was found on this heap, and this year another representing a humpback, from the same heap, was found in the possession of an Indian. This is surpassed in size by a somewhat similar but broken sculpture found at Selma park north of Vancouver. It is the largest unbroken human sculpture in stone known from Canada. Photographs of the front, back, and both sides were taken and negotiations were started for its preservation in this museum or the provincial or British Museum.

Two trepanned human skulls were found in the part of one of these heaps that extends into Washington at Boundary bay and reaches a thickness of about 11 feet. One of these skulls is of a broad type resembling those numerous in the shell-heaps of Port Hammond and Eburne near Vancouver and the skulls of the present Indians of the vicinity. The other is of a very narrow type, of

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which a number of skulls were previously found in the large heap at Eburne, but it is not known to be like that of any living tribe. The perforation in the first is large; in both it tapers suddenly from the outer side of the skull wall to the inner side. That the operation was *ante mortem* is suggested by the fact that of several skulls, similarly perforated, that were previously found at Eburne, one shows a growth of new bone over the opening.

Ontario. The intensive exploration of the Lawson farm site near London, Ontario, begun last year by Mr. Wintemberg, was continued by him from May 18 to July 28. Noteworthy among the finds made were sculptures of the human face. These were on pipe bowls, two of which were of stone and two of pottery. The culture represented by the material found appears to be Neutral-Iroquoian. This exploration is nearly completed.

Office Work

Mr. Smith continued work on his report upon the prehistoric culture of the Bella Coola Indian area. He wrote a report on unique prehistoric carvings from near Vancouver and one on trepanned human skulls from near Vancouver. The album of Prehistoric Canadian Art is in press. Photographic copies of the illustrations in this album and other Canadian art motives were supplied to the Parks Branch of the Department of the Interior, which is co-operating with several government departments in the effort to develop distinctive Canadian manufactures from these motives. The artist of the Parks Branch has already produced a number of designs from this material.

Data regarding the monumental rock sculptures on the island highway near Nanaimo, B.C., and related petroglyphs were supplied to the Parks Branch of the Department of the Interior, the Canadian Historical Society, the British Columbia Historical Society, the Nanaimo Board of Trade, and the Natural History Society of British Columbia. These bodies are co-operating in an effort to conserve these interesting landmarks.

Thirty-four lantern slides of archæological subjects were received from the Photographic Division.

Mr. Wintemberg completed the first draft of his report on the Uren prehistoric village site in Oxford county, Ontario, and began the study of the large collection of pottery from the Roebuck village site, Grenville county, Ontario. His report on "The Eisenhauer Shell-heap, Mahone Bay, Nova Scotia" was sent in for publication.

G. E. Rhoades, for the purpose of studying archæology, gave his time as assistant for the last four months of the year. During this time he studied, rearranged, and relabelled about half of the archæological exhibition.

BIOLOGICAL DIVISION

R. M. Anderson, Chief of the Division, reports:

Since April, 1922, progress has been made in the preparation of exhibits for the Museum halls, although considerable delay has been caused by the difficulty of obtaining proper exhibition cases. Many specimens have been sent in for determination from different parts of the country and numerous requests for information have been answered. Numbers of specimens have also been loaned to schools for the illustration of natural history work, and selected lantern slides for natural history lectures have been loaned extensively to persons engaged in educational or wild life protection and conservation work.

R. M. Anderson, zoologist (mammalia), Chief of the Biological Division, devoted considerable time to the administrative work and correspondence of the division and to the identification and study of the mammal collections. Many notes were added to the card catalogue records of bibliography and field notes

on the distribution and habits of the different species of Canadian mammals. Some time was devoted to editing and proofreading the scientific reports of the Canadian Arctic Expedition, 1913-18, as general editor of these reports for the Arctic Publications Committee. He also represented the Department on the Advisory Board on Wild Life Protection. Leaving Ottawa on August 14, 1922, he proceeded to Grand Cascapedia, Quebec, and from thence went up Cascapedia river to the Federal Zinc and Lead Company's property, where a base camp was established at about 1,800 feet elevation and natural history specimens collected. Later he joined a survey party of the Topographical Division under Mr. Kenneth G. Chipman and remained from August 24 to October 1 in the Lake Ste. Anne and Mount Albert region of Shickshock mountains, Gaspe peninsula, collecting specimens of mammals, birds, and flora, largely above timber-line from 3,500 to 4,000 feet elevation.

The most important addition to the museum collections as a result of this trip is a series of the eastern woodland caribou, which species was previously very poorly represented in the museum. He returned to Ottawa on October 10.

P. A. Taverner, ornithologist, and Hamilton M. Laing, junior zoologist (temporary), did natural history field work in the Okanagan valley, British Columbia, from May 4 to June 21. The time was spent as follows: May 4 to May 19, Osoyoos meadows at head of Osoyoos lake; May 19 to June 15, foot of Vaseaux lake, with June 7 to 10 on the divide between Okanagan and Kettle River valleys, east of Oliver; June 15 to 21, Okanagan Landing. From Okanagan Landing they moved to Comox, on the west coast of Vancouver island, remaining there from June 28 to August 15. Mr. Laing remained at Comox until the last of September. The results of this trip were 880 birds, 8 mammals, about 250 photographs, and about 3 coloured plates of soft parts of birds.

Charles H. Young, senior collector-preparator, left Ottawa May 9 and did field collecting at Waterton Lakes park, in southwestern Alberta, from May 13 to September 30, returning to Ottawa on October 4. His collections numbered 42 birds, 2 nests, 226 mammals, and 500 insects. During the remainder of the year he was occupied in cataloguing and arranging specimens in the Museum.

The following work was done in the preparatory department of the Museum:

Mammal and bird skins prepared for scientific study.....	283
Mammals, birds, and reptiles prepared for exhibition.....	53
Large mammal skins tanned (moose, caribou, bear, fox).....	42
Plaster reproductions (petroglyphs, skulls, reliefs, cast and coloured).....	25
Numerous cast and coloured leaves and grass in wax, plaster exhibition bases, plaster leaf-moulds, material for three bird groups collected.	
Lantern slides, coloured.....	248
Colour plates and drawings.....	19
Lettered labels, photographs, and posters.....	117
Complete skeletons cleaned and mounted.....	9
Complete skeletons cleaned by maceration.....	33
Complete skeletons collected.....	24
Skulls collected.....	8
Skulls cleaned for study purposes, about.....	450

M. O. Malte, Chief Botanist of the National Herbarium, devoted the time from the beginning of the fiscal year to the beginning of October to work on the flora of the Ottawa district. Preparatory to the work in the field examination keys were prepared to all the species so far recorded from the Ottawa district. These keys were tested during the season on plants collected in the field, and were found to work satisfactorily. With the assistance of H. A. Quackenbush, who was engaged as temporary field assistant, a total of about 4,250 herbarium specimens were collected, representing about 1,000 species and varieties. Of this number, over 3,000 herbarium specimens will be available for exchange.

After the return from field work, some time was spent on the determination of plants collected by outside botanists and botanical students. Although such work often may absorb considerable time, it is on the whole fruitful and not infrequently brings out botanical facts and data of great interest. The botanical

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office, therefore, is anxious to co-operate with and to assist collectors and students of botany from all parts of the Dominion, and particularly those who are willing to donate specimens of interesting species and varieties to the National Herbarium in return for assistance given.

Considerable time was spent on editing and proofreading of botanical papers prepared for the Report of the Canadian Arctic Expedition, 1913-18. The following were sent to the printer, viz.:

Charles W. Lowe: Freshwater Algae and Freshwater Diatoms (issued Feb. 20, 1923).
John Dearnness: Fungi (in galley proof at the end of the fiscal year).

During the year some 1,500 pamphlets and separates were secured for the botanical office from the estates of the late Professor John Macoun and the late Mr. James M. Macoun. These pamphlets and separates, together with many hundreds brought to the office by Mr. Malte, will form the nucleus of an office working-library which, it is hoped, will be steadily increased in the future. A special classification and filing system has been evolved which, together with a proper index, promises to make this office library a very valuable and time-saving one.

Plants received, outside of collections by staff:

	Sheets
Gray Herbarium, Cambridge, Mass.....	880
R. H. Wetmore, Cambridge, Mass.....	258
G. Hume, Ottawa.....	22
Frits Johansen, Ottawa.....	10
Wm. Herriot, Galt, Ont.....	59
H. Mousley, Hatley, Que.....	61
C. E. Gustafsson, Trelleborg, Sweden.....	90
W. Watson, Toronto, Ont.....	12
Provincial Museum, Victoria, B.C.....	14
W. R. Carter, Victoria, B.C.....	17
 Total.....	 1,423

At the end of the fiscal year the National Herbarium included about 105,000 mounted and numbered sheets of vascular plants.

Lantern Slides

Report on Bird Lantern Slide service from March 31, 1922, to April 1, 1923:

During this year loans of slides have been made in thirty-seven instances, the slides being used from one to six times in each case, before a total audience of about 6,500. These loans have been distributed over Canada from Truro, N.S., to Calgary, Alberta, including all intermediate provinces, and do not include slides used by the Canadian National Parks for illustrating special subjects nor a number of lectures given by various members of the staff in the city of Ottawa and elsewhere.

A collection of slides from this division is distributed from the Vancouver office of the Geological Survey. It is heard from time to time that these slides are in great demand and are fully appreciated, but no detailed report on them has been received.

The moving picture films of Jack Miner's geese and the Bonaventure Island bird rocks have been in nearly constant use by lecturers of the Parks Branch and have become so worn that new ones have had to be ordered.

The great lack just now is the filling out and increasing of the slide collection. The slides have been shown numerous times in the same locality and it is desirable that new subjects be furnished. The series is also far from complete and many desirable subjects are still lacking. There are negatives and subjects that should be included as soon as the congestion in the photographic division will allow of the slides being made.

MINES BRANCH

John McLeish, Director

Canada's mineral production in 1922 is estimated as having a value of \$183,000,000. The highest production reached in any one year was \$227,860,000 in 1920. The value of the exports of mineral products, including those in all stages of manufacture, was in 1922 about \$115,000,000, and the value of imports during the same year reached a total of \$282,000,000. In 1920 the corresponding exports were valued at \$192,000,000 and the corresponding imports at \$496,000,000. Thus, notwithstanding apparent enormous mineral resources, Canada is a large importer of many mineral products. Economic conditions and geographic distribution of resources play an important part in this international trade, particularly in respect to coal and iron. Nevertheless, greater knowledge of our own resources and particularly of the processes that must be used to recover from them marketable products should result in increased production and diminished imports.

FUNCTION AND ORGANIZATION

The development of Canada's great natural resources should be carried on under laws and regulations designed and administered to serve best the public interest. Production should be made in a manner and under conditions that will give a maximum recovery of marketable ore, will ensure the conservation of minerals not being immediately exploited, and will afford the maximum protection of health and life. Such assistance as is properly within the function of Government to grant should be given to facilitate the development and supply of markets for those minerals that are susceptible of economic exploitation.

The Mines Branch collects the information, and conducts investigations to promote the efficient development and utilization of mineral resources. This is a broad field that extends from the opening up of mineral deposits to the utilization of their products.

The investigations are carried out under five divisions.

Under the Division of Mineral Resources is included the investigation of mineral resources and their technology with particular reference to production, treatment, character, distribution of output, market conditions, market requirements, buyers' specifications, prices, trade, home consumption, foreign production and competition, etc. The importance of this information is attested by the great demand for the reports of the division. It is proposed to so strengthen the staff of this division that an annual review of the mining industries may be issued.

The present division is a consolidation of three former divisions, and it was only lately that the reorganization could be given full effect. At the close of the year several vacancies still remained unfilled.

The Ore Dressing and Metallurgical Division determines methods and processes applicable to the treatment of ores and carries on research into special problems connected with the treatment of Canadian ores. The test work is done in great detail and usually involves a considerable amount of research. Custom work for the actual recovery of values is not undertaken, but the test work is made on samples ranging from a hundred pounds to car-lots.

The Fuel Testing Division investigates the fuels of Canada with particular reference to their character, heating values, coking and retorting, and gas and oil producing possibilities and the processes for their treatment.

Canada has two great fuel problems which are more or less related. One of these is the utilization of our low-grade fuels such as peat and lignite, the other problem is to provide, in central Canada, a fuel to replace American anthracite. In the study of these problems the Mines Branch is co-operating with the Dominion Fuel Board, of which both the Mines Branch Director and the Chief of Fuel Testing Division are members.

What were formerly two divisions have been united in the Ceramics and Road Materials Division.

The ceramic laboratories are equipped to investigate materials used in the clay industries, to determine their physical and chemical characteristics, their behaviour when subjected to firing, and the purposes for which they may be used.

The road materials laboratory is designed to test samples of road materials. The laboratory tests are necessary for the scientific determination of the physical values of road-making materials. The laboratory also investigates special problems connected with the use of road materials such as methods of improving the binding qualities of gravel and macadam roads, and methods for making more serviceable road surfaces prepared from natural soils.

The Chemical Division is fully equipped for the chemical analysis of rocks, ores, minerals, mineral water, oil, gases, mine air, etc. Much work in the way of chemical and physical examinations is done for other Government departments, and as far as possible for the public. Analytical and assay work for the public is subject to appropriate fees. Important chemical research investigations are also undertaken.

CO-OPERATION WITH OTHER ORGANIZATIONS

The Mines Branch endeavours to co-operate to the fullest extent with Provincial and other Government departments, and with scientific organizations engaged in similar lines of investigations.

REVIEW OF ACTIVITIES

The various investigations undertaken during the year are briefly indicated in the following pages. The Director devoted a great deal of time to the work of the Dominion Fuel Board, of which he is vice-chairman. He also acted as a member of the Advisory Committee to the Department of the Interior on mining regulations. In September a visit was paid in company with the chief of the Ore Dressing Division to the more important ore-milling plants in northern Ontario. The annual conventions of several engineering societies were also attended.

MINERAL RESOURCES DIVISION

A. W. G. Wilson, Chief of the Mineral Resources Division, spent about three months in field work in eastern Canada, Alberta, and British Columbia. The balance of the year was devoted to routine work in the office at Ottawa, and to the completion of the report on the Development of Metallurgical and Chemical Industries in Canada. Mr. Wilson's services in a consulting capacity were requisitioned by the Department of Justice in connexion with a case before the Exchequer Court.

H. Frechette, who was also Acting Chief of the Division of Ceramics and Road Materials, spent a part of the summer season investigating deposits of mineral pigments in Ontario, Quebec, and New Brunswick. Samples from various localities were examined and tested in the laboratory of the Ceramics Division.

L. H. Cole spent his third field season in Saskatchewan surveying and sampling the deposits of natural salts found in alkali lakes. This season's work was confined to some of the larger lakes in the district west of Swift Current. Preliminary examinations were made of a number of other lake deposits in the northern parts of Saskatchewan and Alberta, and in British Columbia.

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H. S. Spence completed a report on talc and soapstone in Canada, which was issued in November. He made a general survey of British industries, using non-metallic minerals, and studied the market possibilities for Canadian mineral products. The results of these investigations were published in Memorandum Series No. 6, December, 1922.

A. H. A. Robinson spent most of the year in the office, a part of the time being devoted to the review of the proofs of a report on titanium and to the preparation of maps to accompany this report. A few days were spent in an inspection of a belt of iron formation near Dryden, Ontario.

S. C. Ells spent his sixth season in surveying and sampling the deposits of bituminous sands in northern Alberta. Detailed topographic maps have been prepared covering most of the area in which these deposits occur, many samples have been examined, and available tonnages have been estimated. It is expected that all the necessary mapping will be completed in 1923. The question of further sampling the deposits by drilling is still under consideration.

V. L. Eardley-Wilmot completed a monograph on molybdenum and inspected operations at active properties in Ontario and Quebec producing feldspar, mica, talc, graphite, fluorite, and quartz.

ORE DRESSING AND METALLURGICAL DIVISION

W. B. Timm, Chief of Division, reports that satisfactory progress has been made on the investigations undertaken during the year, and on those carried over from last year.

Additions to the staff included the permanent appointment of J. S. Goddard as junior chemist in November; the temporary appointment of C. L. Dewar as senior laboratory assistant in June, and as engineer, Mines Branch, grade 1, in December; the permanent appointment of L. Lutes as laboratory assistant in October, which position was filled previously by temporary appointments.

INVESTIGATIONS CONDUCTED DURING 1922

The Chief of Division visited a number of the milling, concentration, and metallurgical plants of the west, and northern Ontario, in connexion with the investigations being carried on in the testing laboratories. In connexion with the Eustis and Estelle processes for the production of electrolytic iron from Canadian pyrrhotite and pyrite ores, he and R. J. Traill visited the pilot plant under construction by the Milford Electrolytic Iron Company.

C. S. Parsons conducted the following investigations in the laboratories and in the field:

The concentration of the Flinflon disseminated copper ore of northern Manitoba.

The concentration of antimony ore from lake George, N.B.

The concentration of a copper nickel ore from the Sudbury district, for the Welland Alloy Steel Corporation, Welland, Ont.

The concentration of graphite ore from the Timmins mine, Westport, Ont.

Examination of the gold tailing dumps of Nova Scotia; the recovery of the values in these dumps.

R. K. Carnochan conducted investigations on the following:

The elimination of impurities from the Malagash salt.

The separation of fossil resin from coal, from the Coalmont collieries, B.C.

The wet separation of asbestos from its rock.

The separation of fluorite, calcite, and barite in fluorspar, from Madoc, Ont.

The recovery of the values in gold ore from Bear river, Bedwell sound, Vancouver island.

The concentration of the radioactive minerals from feldspar and quartz from Kearney, Ont.

The recovery of the values in gold ores from the Caribou and Beaver Dam mining districts, Nova Scotia.

The separation of dolomite from magnesite in the Grenville magnesites.

C. L. Dewar conducted investigations on the following:

The recovery of the silver values in the chloridized residues of The Dominion Reduction Company, Cobalt, Ont.

The milling and concentration of the copper-gold ore of the Kitselas Mountain Copper Company, Usk, B.C.

The use of Canadian manufactured re-agents in the flotation of Canadian ores.

H. C. Mabee, besides allotting and supervising the chemical work of the laboratories and conducting fire assay work, has been making a study of the precious metal values in Canadian pyrrhotite ores and in the concentration and reduction products from such ores.

R. J. Traill during the first part of the year assisted with the chemical work in connexion with the above investigations, and latterly has been conducting an investigation on the application of the Eustis and Estelle processes to the treatment of Canadian pyrrhotite and pyrite ores.

B. P. Coyne and J. S. Goddard assisted with the chemical work in connexion with the above investigations.

NEW EQUIPMENT

An electric muffle furnace was installed for assay work.

A pneumatic flotation unit, consisting of two roughing cells and two cleaning cells, was installed for the larger scale flotation tests.

FUELS AND FUEL TESTING DIVISION

B. F. Haanel, Chief of the Division, reports renewed activity. The technical staff was increased during the year by the appointment of R. E. Gilmore, as superintendent of the Fuel Testing Laboratory. E. S. Malloch was promoted to the position of technical engineer of the division.

R. E. Gilmore reports that 181 samples were analysed in the chemical laboratories during the year, which samples were in addition to the analytical work necessary in the investigations reported below. The analytical work on solid fuels was carried out by J. H. H. Nicolls and Harold Kohl, assisted by C. B. Mohr, and that on liquid fuels by P. V. Rosewarne, assisted by A. A. Swinnerton.

Many of the coal samples were substitute household fuels. With the title of "Characteristics of Different Types of Canadian Household Fuels" a paper under the joint authorship of Messrs. Gilmore, Nicolls, and Kohl was published in the Canadian Chemistry and Metallurgy, February, 1923.

INVESTIGATIONS CONDUCTED BY CHEMICAL STAFF

J. H. H. Nicolls made a special study of the various classifications as applied to Canadian coals. He also carried out preliminary friability or handling quality tests on various household fuels. Time was also taken to prepare for publication a report on "Lignite Carbonization; Continuation and Review of Small Scale Experiments," which work was completed early in 1922. This report under the joint authorship of J. H. H. Nicolls and Harold Kohl is to be found in the Mines Branch report of investigations for the year 1921. Bulletin No. 25, Analyses of Canadian Fuels, viz., part IV, Alberta and the North West Territories, was revised by Mr. Nicolls.

Harold Kohl conducted special carbonization experiments on air-dried peat. These tests were made in the commercial-sized ovens of a hardwood distillation plant. A study of the peat charcoal, gas, and tar oil products was made. Mr. Kohl also co-operated with Mr. Nicolls in the preparation of the lignite carbonization report above mentioned.

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A. A. Swinnerton was engaged in special work on oil-shales. Assisted by Mr. Kohl he carried out experiments on the "Ryan" hot oil digestion process for extracting shale oil. A report entitled "Preliminary Report on the Investigation of Oil-shales" was prepared for publication by Mr. Swinnerton, which report covered his special work on oil-shales during the years 1920 and 1921.

P. V. Rosewarne in addition to his regular work on petroleum oils carried out a preliminary survey of the gasoline and lubricating oils as sold in the city of Ottawa. His two papers entitled "Notes on the Burning Quality of Kerosene Oils for Illuminating Purposes" and "The Lubricating Value of Cod Liver Oil" may be found in the Mines Branch report of investigations for the year 1921.

C. B. Mohr assisted during the last six months of 1922 in special work on raw peat. Considerable progress was made on the study of the effect of mechanical and chemical treatment of the wet peat as related to its drying and shrinkage qualities and to the structure and density of the air-dried product.

INVESTIGATIONS AND EXAMINATIONS MADE BY THE CHIEF OF THE DIVISION AND TECHNICAL ENGINEER

B. F. Haanel, Chief Engineer of the Division of Fuels and Fuel Testing, in addition to his regular duties devoted much of his time to the Peat Committee, of which he is secretary, and the Dominion Fuel Board, of which he is a member.

To study the fuel situation he spent about a month in western Canada, and made three trips to the west in connexion with the work of the Lignite Utilization Board to inspect the briquetting plant at Bienfait, and to attend two conferences at Winnipeg. He also visited the Bureau of Mines at Washington in connexion with the Bureau of Mines Lignite Carbonizer, which is to be erected at Bienfait.

Mr. Haanel prepared papers entitled "The Fuel Situation in Canada" and "The Peat Resources of the Central Provinces and Their Utilization for Fuel Purposes," which were read at the general meeting of the Canadian Institute of Mining and Metallurgy, and the meeting of the Ottawa Branch of the Engineering Institute of Canada.

Mr. Haanel spent considerable time in preparing preliminary reports for the Peat Committee and is engaged at present in the preparation of the final report of the Peat Committee.

E. S. Malloch conducted a series of tests at the Fuel Testing Station on the Domestic Hot Water Furnace to determine its efficiency when burning anthracite coal and also to determine the best methods of burning the various fuels which were sold as substitutes for anthracite coal, namely, 72-hour nut coke, pea size anthracite, soft or bituminous coal, egg size gas coke, Welsh anthracite, and peat, and also the following mixtures: egg size gas coke and pea size anthracite, and egg size gas coke and soft or bituminous coal. A report of these tests was prepared by him and published.

Mr. Malloch also attended to the routine work of the structural material laboratory; made eleven calibrations in the pyrometry laboratory; worked in conjunction with the Air Board in designing a method and apparatus for testing the flow of water through radiators of the flying boat type; and attended to the routine work of the office in the absence of Mr. B. F. Haanel.

CERAMICS AND ROAD MATERIALS DIVISION

During the year work in this division was under the direction of Howells Frechette as Acting Chief.

CERAMICS

In addition to his field work, Mr. Frechette visited the kaolin deposits in Amherst township, Papineau district, Quebec. Recent developments in the mine and plant of the Canadian China Clay Company, Ltd., were examined, as well

as the prospect workings of Mr. J. C. Broderick on a near-by lot to the south. In November, advantage was taken of the low water on Gatineau river to re-examine an occurrence of kaolin on the shore of a small island a short distance above Plomb falls.

A series of tests were commenced on Canadian magnesite with a view to extending its use as a refractory material.

Special clay shapes were made for the Ore Dressing Laboratories and the Royal Mint at Ottawa.

ROAD MATERIALS

The investigation of available road materials in Rocky Mountains park was continued by Henri Gauthier. At the end of the 1921 field season there remained 25 miles of the Castle-Windermere road to be examined and sampled. During 1922 this was completed, and successful prospecting was carried on between Massive and Johnson canyon along the Banff-Lake Louise road, where no suitable material for road work had previously been found.

A great deal of information regarding the location and character of the available road materials along the entire mileage of the Banff-Lake Louise and Castle-Windermere highways is now at the disposal of the park officials. The problems of economically improving the binding and the bearing power of certain materials along these roads, in order to secure a satisfactory surface, are now being worked upon in the laboratories.

The investigation on road materials in Nova Scotia, which was commenced in 1920, was continued by R. H. Picher. A study was made of road conditions on all main highways, and a comparison was made of results obtained in road surfacing with different materials under varying conditions. The more important materials, especially bedrock and gravels, were systematically sampled.

A thorough examination along the following main highways was made, and samples were taken of the more important materials found in proximity to them; the Truro-Sydney road; the Halifax-Windsor-Middleton road; the South Shore road from Halifax west to Shag Harbour; the Kentville-Chester road; the Middleton-Bridgewater road; and the Amherst-Parrsboro road. Study was made of a trap rock which is exposed over large areas along the coast of Nova Scotia on the bay of Fundy, and a search was made for gravel for road surfacing south and east of Amherst.

On account of lack of time, some of the main highways remain to be examined, as well as the waste rock from several mines, which is much used locally in road construction.

A series of tests was made in co-operation with Mr. H. H. Scofield, Cornell University, in connexion with the study, by the American Society for Testing Materials, of methods of testing rock for the crushing strength.

An investigation, by laboratory methods, of special problems connected with the use of boulder clay and other natural soils as surfacing materials for the Rocky Mountains Park roads, was also undertaken.

CHEMISTRY DIVISION

The work of the chemical laboratory, under the direction of F. G. Wait, Chief of the Division, has been along the usual lines of special investigations and of routine. During the year, chemical analyses, assays, physical examinations or identifications of 857 samples have been made, of which 114 were for other Government departments.

R. T. Elworthy, in co-operation with the Geological Survey and Professor A. E. Flynn of the Nova Scotia Technical College, Halifax, commenced a study of kerogen in Nova Scotia torbanites. Kerogen is regarded as the oil-forming

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constituent of oil-shales and torbanites, which in Nova Scotia are rich in this material. A method of its separation having been developed, the study of its chemical properties and origin has accordingly been facilitated. At the request of the Department of Marine and Fisheries he inquired into the cause and possible prevention of smoke fog at Three Rivers, which it is claimed constitutes a danger to navigation on the river at that point.

He constructed and calibrated on behalf of the Mining Lands and Yukon Branch of the Department of Interior, an instrument for rapidly determining the amount of saline matter in waters leaking into oil and gas wells.

He analysed, for the Mineral Resources Division of this branch, a fossil resin from the coal seams at Coalmont, B.C., to ascertain its economic possibilities; and in continuation of the work on natural gas, he studied the production of such chemical products as ethylene, formaldehyde, and carbon black; and made a physical examination of varnishes for the Department of Militia and Defence.

H. A. Leverin's services, as was the case during the preceding three years, were loaned to the Peat Committee, he being employed for special investigations for that body. When this work terminated in 1922 he compiled data for the final report of the Peat Committee. In 1923 he visited various industries which use sodium sulphate, to collect data as to standards of purity and other trade requirements for the utilization of that commodity. This work was in connexion with the investigation of alkali deposits in western Canada, which is now being carried on in the Mineral Resources Division.

R. J. Offord, laboratory assistant, has aided in carrying out much of the experimental part of these investigations.

E. A. Thompson devoted the greater part of his time to a continuation of the study of bentonite, the work upon which is nearing completion. He also made several microscopic examinations of minerals and metals.

Alfred Sadler, in addition to his routine work, examined samples of clays to ascertain their suitability as substitutes for fuller's earth; and also assisted in the work upon bentonite.

James Moran was engaged almost entirely in mine air analyses. During the year, 272 samples have been examined and reported upon.

Mention must be made of the very efficient services rendered by Charles Langley, the glass worker of this branch. He has made and repaired numerous pieces of apparatus, many of special character, without which much of the work would have been seriously delayed, if not made impossible. Other departmental laboratories have been greatly benefited by the work he has done for them.

DOMINION OF CANADA ASSAY OFFICE, VANCOUVER, B.C.

George Middleton, manager of the office, reports the receipt of deposits during the calendar year ended December, 1922, as follows:

There were 1,646 deposits received, melted, assayed, and purchased during the calendar year just ended, an increase of 186 over the previous year and 300 more than in 1920.

The total value of the deposits in 1922 is less than in 1921, due principally to the fact that some of our larger shippers have for various reasons temporarily reduced their gold output. The shortage of water in certain districts during the past season was also a factor in the situation.

A total of 1,710 meltings and 1,710 assays (in quadruplicate) was required in connexion with the purchase and disposal of the bullion, including the melting into large bars of the smaller deposits after purchase, and the assaying of same prior to shipment to the Royal Mint, Ottawa.

The aggregate weight of deposits before melting was 129,891.63 troy ounces and after melting 125,731.21 troy ounces, showing a loss in melting of 3.1821 per cent. The loss in weight by assaying was 27.20 troy ounces, making the weight of bullion after melting and assaying 125,731.21 troy ounces, the average fineness of same being 0.807 $\frac{3}{4}$ gold and 0.147 $\frac{1}{2}$ silver.

The net value of the gold and silver contained in deposits was \$2,105,989.64 as follows:

	Number of deposits	Weight		Net value
		Before melting and assaying	After melting and assaying	
		Troy oz.	Troy oz.	
<i>Bars, Nuggets, and Dust, Amalgam, etc.—</i>				
British Columbia.....	645	54,950.82	52,235.03	\$ 936,607 08
Yukon Territory.....	485	69,161.19	68,273.78	1,126,701 93
Alaska.....	8	35.49	34.20	646 53
Siberia.....	2	218.31	211.33	3,582 08
<i>Dental and Jewelry Scrap—</i>				
British Columbia.....	440	4,744.65	4,293.73	32,543 18
Alberta.....	37	498.41	442.56	3,532 58
Saskatchewan.....	27	277.10	235.18	2,289 36
Manitoba.....	2	5.66	5.40	86 90
	1,646	129,891.63	125,731.21	\$ 2,105,989 64

DRAUGHTING DIVISION

H. E. Baine, Chief Draughtsman, reports that during the fiscal year, eleven maps were completed and published; four maps were completed and are ready for publication, awaiting order to print.

Six maps received during the latter part of the year are now in preparation.

Maps Published During Fiscal Year

532. Deposits of sandstone and gravel available for highway construction between Cardinal and the Quebec boundary; scale, 2 miles to 1 inch. Accompanying report No. 530.
557. Distribution of sandstone in the district of Nelles Corners, Haldimand county, Ont.; scale, 1 mile to 1 inch. Accompanying report No. 555.
558. Distribution of sandstone in the district north of the St. Lawrence river between Kingston and Brockville, Ont.; scale, 3.95 miles to 1 inch. Accompanying report No. 555.
559. Distribution of sandstone in the vicinity of Ottawa, Ont.; scale, 3.95 miles to 1 inch. Accompanying report No. 555.
560. Distribution of sandstone in the vicinity of Montreal, Que.; scale, 3.95 miles to 1 inch. Accompanying report No. 555.
561. Sketch map of quartzite deposits in the townships of Chavigny and Mautaban, Que.; scale, $\frac{1}{2}$ mile to 1 inch. Accompanying report No. 555.
562. Distribution of quartzite in the Kamouraska district, Que.; scale, 7.89 miles to 1 inch. Accompanying report No. 555.
563. Sketch map of the Pilgrim islands, St. Lawrence river, near St. Andre, Kamouraska county, Que.; scale, 2,000 feet to 1 inch. Accompanying report No. 555.
581. Magnetometric map of Orton mine, Hastings county, Ont.; scale, 200 feet to 1 inch (second edition). Accompanying report No. 579.
582. Magnetometric map of Seine Bay titaniferous magnetite range, Rainy River district, Ont.; scale, 400 feet to 1 inch. Accompanying report No. 579.
585. Principal talc and soapstone occurrences in the Eastern Townships, Que.; scale, 8 miles to 1 inch. Accompanying report No. 583.

Maps Ready for Publication

Maps to accompany report on road materials completed during the year and ready for publication, prepared on a scale of 1 mile to 1 inch:

Road materials available for highway construction between Prescott and Gananoque, Ont.

Road materials available for highway construction between Gananoque and Napanee, Ont.

Road materials available for highway construction between Napanee and Port Hope, Ont.

Road materials available for highway construction in the counties of Soulanges and Vaudreuil, Que.; scale, 1 mile to 1 inch.

Maps in Preparation

Map showing molybdenite occurrences in Quebec and the Maritime Provinces; scale, 35 miles to 1 inch.
 Map showing molybdenite occurrences in Ontario; scale, 35 miles to 1 inch.
 Map showing molybdenite occurrences in British Columbia; scale, 35 miles to 1 inch.
 Map showing molybdenite occurrences in Manitoba; scale, 35 miles to 1 inch.
 Harricanaw map-area, showing Indian peninsula and Benjamin deposits, Quebec; scale, 10 miles to 1 inch.
 Map showing molybdenite occurrences in Atlin Mining division, British Columbia; scale, 35 miles to 1 inch.
 Map showing molybdenite occurrences in northern British Columbia; scale, 35 miles to 1 inch.

One hundred and fifty-six page maps, drawings, charts, and flow-sheets were prepared for illustration in the various reports.

Three hundred and fifty negatives and black and white prints were made from the photostat machine.

Two hundred and fifty-eight negatives, black and white, and blue prints, were made from the blue print machine.

Two hundred and sixty halftone blocks and zinc cuts were sent out, received, and filed during the year.

The personnel of the staff at present consists of three senior map draughtsmen (one temporary) and one map draughtsman.

A second attempt was made to secure by examination an appointment to a vacant position of map draughtsman. A number of candidates applied but none was qualified.

DISTRIBUTION OF PUBLICATIONS

During the year 1922, 18,440 publications were distributed by the Distribution Division of the Mines Branch. Of these, 4,008 were sent to applicants, and 14,332 were sent to addresses on the mailing list.

A more comprehensive system of distribution has been effected, the result being increased efficiency.

LIBRARY

Mrs. O. P. R. Ogilvie, Librarian, reports that the growth of the Mines Branch Library for 1922 has far exceeded the shelving accommodations, and that much time has been devoted to the shelving problem.

An intensive effort has been made toward assembling publications on the fuels of the world, with special reference to Canada's fuels, with gratifying results.

ACCESSIONS TO LIBRARY, 1922

Books (by gift).....	11
Books (by purchase).....	422
Books (bound).....	141
Canadian Government documents.....	336
Foreign documents.....	1,129
Scientific societies (bulletins, proceedings, and transactions).....	409
Pamphlets.....	161
Trades catalogues.....	86
Maps.....	28
 Total accessions.....	 2,623

EXPLOSIVES DIVISION

Lt.-Col. G. Ogilvie, Chief Inspector of Explosives

The number of explosives factories now under licence, and including five for the manufacture of fireworks, is sixteen. Three have ceased operations in the course of the year; those of the Canadian Explosives, Ltd., at Windsor Mills, Quebec, for the manufacture of black powder, the Thompson Powder Company, at Deseronto, Ont., and the Jackson Signal Company, at Guelph, Ont. The manufacture of black blasting powder has been transferred from Windsor Mills to the Canadian Explosives Companies' plant at Beloeil, Quebec. The factory at Nobel, Ont., for which a licence is still held, has not recently been in operation. Nevertheless the production of explosives belonging to classes I, II, III, and IV, comprising various commercial blasting explosives, with a relatively small quantity of propellant powders, showed an increase of nearly 10 per cent over that of the previous year. The inspections of the factories did not disclose any serious infraction of the regulations or terms of licence calling for special action. Such minor irregularities as were observed were promptly dealt with by licencees and, indeed, a gratifying feature of these inspections was the marked evidence found of action taken by most manufacturers towards ensuring the compliance of their staffs with both the spirit and letter of the regulations.

Progress has been made in improving the construction of magazines which had been allowed to continue in operation subject to improvements being effected, as well as in the establishment, in a number of cases, of new magazines to replace old ones of not very satisfactory types. One hundred and forty-nine magazines of a permanent or semi-permanent character are now under licence or continuing certificate, and in addition there are in force one hundred and thirty licences covering the use of temporary magazines. The reports of inspections of the division, and those rendered by the Royal Canadian Mounted Police indicate that the conditions of maintenance are steadily improving, although in a few cases it has been found necessary to prosecute licencees for serious breaches of the regulations, or to withhold the renewal of licences.

To a limited extent, stores in which ammunition and a small quantity of explosives may be kept without a licence, have been visited by the inspectors of the division, and have been extensively visited by the Royal Canadian Mounted Police. The regulations in respect to such stores have now been well brought to the attention of dealers and have, on the whole, been observed. Occasionally the instruction given has proved insufficient to obtain compliance with the regulations, continued breaches of which have made it necessary to take legal proceedings. Prosecutions were instituted in nineteen cases and convictions obtained in all.

Four hundred and ninety permits for importation were issued during the year under review.

Eighty-three samples of new explosives were submitted for authorization. Of these, sixty-two were accepted and twenty-one rejected. Explosives amounting in all to over 8,000 pounds were found in a deteriorated, and sometimes dangerous, condition in over twenty different places of storage and were destroyed.

Information was obtained in respect to one hundred and thirty-five accidents with explosives, causing the death of twenty-four persons and injury to one hundred and twenty-nine others during 1922. Of these eight occurred in explosives factories and involved the death of two persons and injuries to

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one other. Three of these accidents were subjects of special inquiries and reports. The others were minor accidents, but of some technical interest. No accident occurred in magazines licensed under the Act nor in connexion with the storage of explosives in unlicensed premises, nor in the conveyance.

The other accidents occurring under circumstances not immediately controlled by the Act have been classified according to their circumstances or causes, and are dealt with in the Annual Report of the Explosives Division. They included three explosions in mine magazines whereby four men were killed and four injured. Sixty-five accidents were associated with shot firing, twenty-seven arose from persons playing with detonators, eleven from playing with other explosives, and twenty-one were of a miscellaneous character.

EDITORIAL DIVISION

William McInnes, Editor-in-Chief

The Department issues from time to time reports, memoirs, bulletins, and pamphlets from its various divisions. The publications of the Geological Survey and Victoria Memorial Museum were issued under the supervision of F. Nicolas, Editor; those of the Mines Branch, under the supervision of Samuel Groves, Editor, up to June 30, 1922, when he resigned, and the work was continued by J. J. Bell. In addition to the reports issued in English, some are issued in French, under the supervision of Jobson Paradis, C. E. Rivier, and E. P. Lévesque.

The last General Index of Geological Survey reports was published in 1908. Many requests have been received, both from Canadian and foreign sources, for an Index covering the reports to a later date; and, in view of these insistent requests, the compilation of an Index to cover all Summary and "Separate" reports to the end of 1916 has been commenced, and publication is expected about September, 1923.

The following lists include the publications issued by the Department during the fiscal year 1922-1923, and the French publications distributed during that period:

DEPARTMENT OF MINES

English Publications

No.

1968. *Report of the Department of Mines for the Fiscal Year Ending March 31, 1922*; 48 pages; 4,000 copies; published December 30, 1922.

French Publications

1954. *Rapport du Ministère des Mines pour l'année financière se terminant le 31 mars 1921*; 49 pages; 1,000 copies; published Sept. 24, 1922.

Liste des Publications françaises du Ministère des Mines; 7 pages; 500 copies; published Dec. 12, 1922.

GEOLOGICAL SURVEY

English Publications

1563. Memoir 104. Biological Series 3. *Birds of Eastern Canada*. (Second Edition)—by P. A. Taverner; 290 pages; 50 coloured plates; 68 figures; 15,000 copies; published June 24, 1922.

1898. Memoir 126. Biological Series 4. *A Botanical Exploration of the North Shore of the Gulf of St. Lawrence, including an Annotated List of the Species of Vascular Plants*—by Harold St. John; 130 pages; 6 plates; 2 maps; 2,000 copies; published April 4, 1922.

1938. Bulletin No. 34. Geological Series 41. *Physiography and Glacial Geology of Gaspe Peninsula, Que.*—by A. P. Coleman; 52 pages; 7 plates; 5 figures; 1 map; 2,500 copies; published April 4, 1922.

1944. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1921, Part E*; 61 pages; 3 figures; 3,500 copies; published October 19, 1922.

1946. Bulletin No. 36. Biological Series 8. *Land Snails from the Canadian Rockies*—by S. Stillman Berry; 19 pages; 1 plate; 2,500 copies; published May 15, 1922.

1947. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1921, Part C*; 36 pages; 6 figures; 2 maps; 3,000 copies; published May 17, 1922.

1949. Memoir 130. Geological Series 111. *Geology and Mineral Deposits of the Bridge River Map-area*—by W. S. McCann; 115 pages; 11 plates; 11 figures; 2 maps; 3,000 copies; published Aug. 31, 1922.

1950. Memoir 131. Geological Series 112. *Kenogami, Round, and Larder Lakes Areas, Timiskaming District, Ont.*—by H. C. Cooke; 64 pages; 2 figures; 3 maps; 3,500 copies; published July 13, 1922.

1955. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1921, Part A*; 121 pages; 4 plates; 24 figures; 7 maps; 4,000 copies; published Aug. 11, 1922.

1958. *Summary Report of the Geological Survey, Department of Mines, for the Calender Year 1921, Part D*; 110 pages; 5 plates; 7 figures; 7 maps; 3,500 copies; published July 26, 1922.

1959. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1921, Part B*; 104 pages; 6 plates; 3 figures; 3 maps; 4,000 copies; published Nov. 13, 1922.

1966. Bulletin No. 35. Geological Series 42. *Relationship of the Precambrian (Beltian) Terrain to the Lower Cambrian Strata of Southeastern British Columbia*—by S. J. Schofield; 2 figures; 2,500 copies; published Nov. 24, 1922.

1967. Memoir 132. Geological Series 113. *Geology and Ore Deposits of Salmon River District, B.C.*—S. J. Schofield and G. Hanson; 81 pages; 4 plates; 6 figures; 1 map; 3,000 copies; published Dec. 16, 1922.

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974. Memoir 133. Geological Series 114. *The Southern Portion of the Sydney Coal Fields, N.S.*—by A. O. Hayes and W. A. Bell; 108 pages; 3 figures; 1 map; 3,000 copies; published March 31, 1923.

List of Publications of the Geological Survey; 13 pages; 1,000 copies; published October 13, 1922.

*Report of the Canadian Arctic Expedition 1913-1918*¹

Volume III: *Insects*, Title page, Preface, Contents, and Index, for final volume; 10 pages; 3,000 copies; published Jan. 2, 1923.

Volume IV: *Botany, Part A, Freshwater Algae; and Freshwater Diatoms*—by Charles W. Lowe; 53 pages; 5 plates; 3,500 copies; published Mar. 21, 1923.

French Translations

1564. Mémoire 104. No. 3 Série biologique. *Les Oiseaux de l'Est du Canada*. (Second Edition)—by P. A. Taverner; 308 pages; 50 coloured plates; 68 figures; 5,000 copies; published Mar. 31, 1923.

1930. Mémoire 124. No. 106 Série géologique. *La partie nord-est du Labrador et le Nouveau-Québec*—by A. P. Coleman; 82 pages; 10 plates; 3 maps; 1,000 copies; published April 25, 1922.

MINES BRANCH

English Publications

482. *Analysis of Canadian Fuels, Part IV: Alberta and the Northwest Territories* (Second Edition) Bulletin No. 25—by Edgar Stansfield and J. H. H. Nicolls; 77 pages; 4,000 copies; published April 30, 1922.

549. *Structural Materials along the St. Lawrence River, between Prescott, Ont., and Lachine, Que.* Report on—by Joseph Keele and L. Heber Cole; 119 pages; 30 plates; 5 figures; 3 maps; 3,000 copies; published Sept. 27, 1922.

570. *Barium and Strontium in Canada*. Report on—by Hugh S. Spence; 100 pages; 15 plates; 18 figures; 4,000 copies; published June 16, 1922.

579. *Titanium*. Report on—by A. H. A. Robinson; 127 pages; 5 figures; 2 maps; 3,000 copies; published Mar. 31, 1923.

583. *Talc and Soapstone in Canada*. Report on—by Hugh S. Spence; 85 pages; 2 plates; 15 figures; 1 map; 4,000 copies; published Nov. 4, 1922.

Mines Branch Experimental Ore Testing and Research Laboratories, Ottawa. Pamphlet; 4 pages; 2,000 copies; published July 17, 1922.

Instructions for Burning Bituminous Coal, Coke, Welsh Anthracite, and Other Fuels and Fuel Mixtures in Standard House Furnaces. Pamphlet; 7 pages; 100,000 copies; published Jan. 27, 1923.

Directions for Burning Bituminous Coal in Standard House Furnaces. Circular; 1 page; 500,000 copies published Feb. 8, 1923.

List of Mine Operators

Coal mines in Canada; published Jan. 15, 1923.

Metal mines in Canada; published Jan. 30, 1923.

Metallurgical works in Canada; published Oct. 17, 1922, and Jan. 2, 1923.

French Translations

569. *La production minérale du Canada pour l'année civile 1920*. Annual Report on—by John McLeish; 82 pages; 1,000 copies; published July 31, 1922.

Instructions pour le chauffage au Charbon bitumineux, au Coke, à l'Anthracite gallois, et autres combustibles et mélanges, dans les calorifères. Pamphlet; 7 pages; 30,000 copies; published Feb. 5, 1923.

Instructions pour le chauffage au Charbon bitumineux dans les calorifères. Circular; 1 page; 500,000 copies; published Feb. 8, 1923.

EXPLOSIVES DIVISION

English Publication

7. *Annual Report of the Explosives Division, Department of Mines, for the Calendar 1922*; 20 pages; 2,000 copies; published Mar. 31, 1923.

French Translation

6. *Rapport annuel de la Division des Explosifs, du Ministère des Mines, pour l'année civile 1921*; 18 pages 1,250 copies; published May 30, 1922.

REPORTS IN PROGRESS ON MARCH 31, 1923

At the end of the fiscal year 1922-1923 the Geological Survey had, in the hands of the King's Printer, five English reports and one French translation; the Mines Branch, two English reports, two lists of mine operators, and one French translation.

DISTRIBUTION OF FRENCH PUBLICATIONS

The French publications of the Department of Mines, including those of the Geological Survey, the Mines Branch, and the Explosives Division, are distributed under the supervision of the Editorial Division of the Department. During the fiscal year 1922-1923, there were distributed 4,963 copies in Canada and in foreign countries. Of these, 2,737 were sent in compliance with written or personal requests, and 2,226 copies to the addresses on the mailing lists.

¹These reports were published under the supervision of R. M. Anderson, Chief, Biological Division

ACCOUNTING DIVISION

ACCOUNTANT'S STATEMENT

P. R. Marshall

The funds available for the work and expenditure of the Department of Mines for the fiscal year ending March 31, 1923, were: -

	Grant	Expenditure		Total
		Amount	Total	
	\$ cts.	\$ cts.	\$ cts.	
DEPARTMENT—				
Amounts voted by Parliament.....	255,067 92			
Lignite Utilization Board.....		152,500 00		
Civil list salaries.....		55,884 67		
Expenses of Explosives Division.....		8,492 56		
Grant to Imperial Mineral Resources Bureau.....		7,300 00		
Civil Government contingencies.....		6,510 90		
Grant to Canadian Institute of Mining and Metallurgy.....		3,000 00		
Provisional bonus allowance.....		2,441 25		
Allowance for Private Secretary.....		600 00		
Expenditure chargeable to Superannuation Fund No. 4, Retirement Act.....		466 67		
Balance unexpended and lapsed.....				237,196 05
				17,871 87
GEOLOGICAL SURVEY—				
Amounts voted by Parliament.....	631,671 53			
Advances unaccounted for 1921-22.....	1,900 00			
Civil list salaries.....		259,509 40		
Explorations, surveys, and investigations.....		172,306 37		
Publication of reports and maps.....		46,599 31		
Wages of temporary employees.....		25,436 97		
Sundry printing and stationery.....		21,050 93		
Provisional bonus allowance.....		11,480 32		
Miscellaneous.....		4,469 73		
Instruments and repairs.....		2,362 71		
Photographic supplies.....		1,844 25		
Laboratory.....		1,785 33		
Specimens for Museum.....		1,219 97		
Miscellaneous gratuities.....		600 00		
Balance unexpended and lapsed.....				548,665 29
				84,906 24
MINES BRANCH—				
Amounts voted by Parliament.....	331,054 80			
Advances unaccounted for 1921-22.....	100 00			
Civil list salaries.....		124,118 04		
Investigation of mineral resources.....		41,912 73		
Expenses of fuel testing plant and laboratory.....		33,027 98		
Expenses of ore dressing and metallurgical laboratory.....		26,798 83		
Peat fuel investigations.....		17,160 21		
Publication of reports and maps.....		11,680 39		
Wages of temporary employees.....		10,585 84		
Sundry printing and stationery.....		9,613 34		
Provisional bonus allowance.....		6,879 60		
Chemical laboratory.....		3,142 57		
Miscellaneous.....		2,739 80		
Expenses of Dominion Fuel Board.....		246 51		
Miscellaneous gratuities.....		206 80		
Advances 1922-23 to be accounted for 1923-24.....		1,010 40		
Balance unexpended and lapsed.....				289,123 04
Forward.....	1,219,794 25			42,031 76
				1,219,794 25

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ACCOUNTANT'S STATEMENT—Continued

	Grant	Expenditure	
		Amount	Total
Forward.....	\$ 1,219,794 25	\$	\$ 1,219,794 25
DOMINION OF CANADA ASSAY OFFICE—			
Amounts voted by Parliament.....	26,786 00		
Earnings.....	2,255 44		
Salaries of staff.....		18,180 00	
Assayers' supplies.....		1,266 50	
Fuel, power, and light.....		1,182 63	
Contingencies.....		928 27	
Provisional bonus allowance.....		786 00	
Premium on bonds.....		555 00	
Electric Burglar Alarm service.....		360 00	
Balance unexpended and lapsed.....			23,258 40
			5,783 04
	1,248,835 69		1,248,835 69

Summary

	Grant	Expenditure		Grant not used
		\$	cts.	
Civil Government salaries.....	508,162 50	440,112 11		68,050 39
Department.....	188,940 00	177,803 46		11,136 54
Geological Survey.....	322,000 00	275,076 86		46,923 14
Mines Branch.....	176,500 00	157,800 20		18,699 80
Assay Office.....	\$ 26,000 00	28,255 44	22,472 40	5,783 04
Earnings.....	2,255 44			
Provisional bonus allowance.....		21,587 17	21,587 17	
Miscellaneous gratuities.....		806 80	806 80	
Expenditure chargeable to Superannuation Fund No. 4, Retirement Act.....		466 67	466 67	
Increases due to re-classification.....		117 11	117 11	
Advances unaccounted for 1921-22 accounted for in 1922-23..	1,246,835 69	1,096,242 78		150,592 91
	2,000 00	2,000 00		
	1,248,835 69	1,098,242 78		150,592 91

Casual Revenue

Sales of school collections, equipment, explosives permits, etc.....	\$ 3,725 92
Revenue from fines for violations of Explosives Act.....	191 79
Refunds, adjustment of Provisional bonus allowance.....	50 43
Adjustment of claims for equipment lost.....	43 80
	\$ 4,011 94

APPENDIX

REPORTED DISCOVERY OF PLACER GOLD IN LABRADOR

(Statement Issued by the Geological Survey, Ottawa, May 7, 1923. Reprinted by Request of Joint Committee of both Houses on the Printing of Parliament)

As the Geological Survey is receiving from Canadian prospectors and investors many inquiries for information regarding the reported discovery of placer gold near Stag bay, Labrador, it has been decided to make public what information it possesses regarding the reported discoveries and the geological features that have a bearing on the probable existence of placers. The claims that have been staked have been recorded with the Government of Newfoundland; consequently the Geological Survey of Canada has made no field investigations in the area since the discovery was reported, and has no first-hand knowledge of the alleged placers. During the past, however, officers of the Survey and geologists from other institutions have explored the Labrador coast, and a good deal is known about its geological features.

Stag bay lies 30 or 40 miles west of cape Harrison, north of Hamilton inlet. It is described by A. S. Packard, who entered it, as a wide sound bordered by lofty, terraced hills. Robert Bell¹ made observations at points along the Labrador coast; A. P. Low² along the coast and on lake Melville; and more recently—1921—E. M. Kindle on lake Melville and along the coast south of Hamilton inlet. Our knowledge of the geology of the southern part of the coast is based largely on work done by A. S. Packard³ and by R. A. Daly⁴, and of the northern part of the coast by A. P. Coleman⁵.

The existence and preservation of placers are affected in large measure by glaciation, for the reason that glaciation, or ice action, tended to carry away and destroy any placers that accumulated before the Ice age, and there has not been time enough since then for new ones to form. Most geologists believe that all except the elevated parts of the very northern stretch of the Labrador coast was intensely glaciated by a continental ice-sheet that moved seaward in a direction at right angles to the general northwest trend of the coast.

Dr. Coleman, who spent parts of two summers in a study of the northern part of Labrador and the adjacent part of Quebec, after briefly describing the plateau of the Canadian shield, says:

"The loftier parts of this tableland rise near the coast from mount Thoresby (2,733 feet) near Nain, to Ryan bay near Eclipse harbour (four peaks said to be from 5,000 to 6,000 feet in height), with a length of about 230 miles from southeast to northwest. It must not be supposed, however, that these higher points form a distinct range of mountains. In most cases they are merely a mountainous fringe on the seaward side of a somewhat narrow tableland, and they are broken up into shorter or longer sections separated by lower areas. From southeast to northwest may be seen the Kiglapaits, north of mount Thoresby; to Kaumajets, near Okak and Mugford; and the highest part of all, named the Torngats by Daly and others, extending from Saglek bay to Ryan bay, with a length of nearly 100 miles."

Most of Dr. Coleman's work was devoted to the central part of the mountains known as the Torngats. With regard to glaciation of the northern part of the coast he writes:

¹ Geol. Surv., Can., Rept. of Prog., 1882-83-84, part DD. Scottish Geog. Mag., vol. II, 1895.

² Geol. Surv., Can., Ann. Rept., vol. VIII, pt. L.

³ "Observations on the Glacial Phenomena of Labrador and Maine," Boston Soc. Nat. Hist., Mem., vol. I.

"The Labrador Coast, a Journal of Two Summer Cruises in that Region, 1891."

⁴ "Geology of Northeast Coast of Labrador;" Mus. of Comp. Zool., Bull., vol. 38.

⁵ Geol. Surv., Can. Mem. 124.

"The evidence of glacial action is absent from a considerable area in northeastern Labrador, since the higher tableland and the tops of the mountains which fringe it on the Atlantic side show no marks of having been overridden by an ice-sheet. The area left unglaciated cannot yet be exactly outlined owing to the absence of observations over most of the region; but it is known that along a coastal belt extending from Saglek to Komaktorvik, a distance of 80 miles, there is no appearance of ice action above the valleys. At Nachvak this unglaciated condition is known to reach at least 50 miles inland, giving a 'driftless area' of perhaps 3,000 or 4,000 square miles. The tops of the Kiglapait and Kauniat mountains to the south and of the Four Peaks to the north, as well as many other isolated peaks, probably rose as nunataks above the surrounding ice."

"The unglaciated character of the higher levels at Nachvak and northward was noted by Lieber and Bell, who remark upon the jagged character of the mountains as incompatible with the passage over them of an ice-sheet. Daly goes more fully into the question and reaches the conclusion that Nachvak glacial ice did not reach higher than 2,100 feet above sea-level. The idea suggested by these writers that the Labrador ice-sheet made its way through depressions in the tableland, such as Nachvak fiord, and reached the Atlantic, is not borne out by the writer's observations."

"Though the northeastern peninsula of Labrador was not covered by the great ice-sheet, its depressions were occupied during the Ice age by long and large glaciers which scoured out the valleys and in many places left deposits of boulder clay and moraines. This work seems to have been done, in part at least, toward the end of the Glacial period, as shown by the unweathered character of some of the deposits and of the lower glaciated surfaces; whereas old-looking, strongly indurated till in other places was probably laid down earlier."

"The small existing glaciers may be looked on as remnants of these far greater valley glaciers."

"South of the unglaciated area mentioned above, there can be no doubt that the continental ice-sheet reached the sea, since even hill tops present moutonnées forms and erratic blocks, though striated surfaces are seldom seen except on the lower levels. Distinct moraines and boulder clay are not common, probably because the region was one of erosion rather than deposit, but morainic material and till may have been deposited off what is now the coast on the submerged continental shelf."

A. S. Packard says that the "whole Labrador plateau has been moulded by ice to a height at least of 2,500 feet above the level of the sea . . . Only at one point near the northern termination of the peninsula at cape Chudleigh have the mountains by their attitude escaped the rounding and remodelling action of glaciers." He and others point to the rounded character of the hills, the roches moutonnées, the glacial striæ, the lunoid markings, and the transported boulders as convincing evidence of glaciation.

R. A. Daly, in describing the coast from Belle Isle to Paul island, which includes Stag bay, says that "from any commanding hill on island or mainland, the eye ranges far and wide over a surface showing everywhere the evidence of universal and profound glaciation. Unobscured by forest, soil, or thick drift, and singularly expanded because of the crystalline clearness of the atmosphere, the view typifies that which may be had in the Laurentian highlands of Canada or in the Archaean of the Scottish highlands. It is a great wilderness of innumerable, rounded, ice-worn hummocks, generally gneissic in composition. Among the roches moutonnées lie equally countless ponds and bogs connected by the small streams of a most disordered drainage."

Packard, Daly, Coleman, and Kindle call attention to the paucity of glacial deposits other than boulders. The area was evidently, as Coleman states, one of erosion rather than deposition and the great bulk of the loose material resulting from pre-Glacial weathering may have been swept, as suggested, to the sea and deposited on the submerged continental shelf.

It is thus seen that conditions have been produced in that part of Labrador extending from the south end to much farther north than Stag bay, similar to those existing in northern Ontario. Both are underlain by Precambrian rocks and both have been subjected to intense glaciation. Geologists and prospectors have learned to look upon northern Ontario as unfavourable ground for prospecting for placers. Placers that may have existed before the Ice age are believed to have been destroyed and scattered by the eroding action of the great mass of moving ice.

SESSIONAL PAPER No. 15

A few placers have been formed since the Ice age, but they have never paid to work because the gold is scattered through the glacial drift and has been only slightly concentrated in the Recent gravels. It is very unlikely that placers have been formed in Labrador since the Ice age. As has been pointed out, the coast of Labrador, except the very northern part, has been swept clean of nearly all unconsolidated material, pre-Glacial and Glacial, except boulders; there is little likelihood, therefore, of placers having been formed by a re-sorting of glacial debris, and sufficient time has not elapsed since glaciation for the breaking down of great thicknesses of rock necessary for the formation of new placers.

Rich placers do occur in some glaciated regions, for example in the Cariboo district of British Columbia, but the Labrador region was more intensely glaciated than the Cariboo. Cariboo is a mountainous region with deep and narrow valleys and the ice-sheet could not move freely because of these deep valleys and because it was hemmed in by mountains. In Labrador the ice could move freely and its scouring action was pronounced. Although it cannot be said that placers will not be found in Labrador, the chances for the occurrence of rich ones seem very remote.

In view of the above some of the statements that have appeared in advertisements of the reported Labrador placers seem improbable. It has been implied, for example, that there may be considerable areas of gravel, 21 feet thick, carrying \$100 in gold per cubic yard. Neither does the evidence of the actual discovery of placer gold, as given in advertisements by promoting companies, appear satisfactory. It is apparently based mainly on a statement claimed, in advertisements, to have been made by Ledoux and Company, New York, concerning an assay of a sample of gold-bearing gravel from Labrador. Correspondence, however, with Ledoux and Company, has elicited the information that they had been unable to find any record of such a sample having been submitted to them and that no such sample had been submitted to them either by H. C. Bellew or Richard W. Edwards.

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